THE AMERICAN GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

May Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, May 1, 1897.

The May meeting of the Society of Gas Lighting will be held in the Arena, No. 39 West 31st street, New York city, at 3 P.M., of the 13th inst.

FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

May Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, May 1, 1897.

The May meeting of the Guild of Gas Managers will be held in Young's Hotel, Boston, Mass., at noon of Saturday, the 8th inst.

A. K. QUINN, Secretary.

[OFFICIAL NOTICE.]

Twentieth Annual Meeting, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW ALBANY, IND., April 13th, 1897.

The 20th annual meeting of the Western Gas Association will be held at Cincinnati, O., May 19th, 20th and 21st, 1897, and will be called to order by the President, Mr. W. H. Odiorne, at 10 A.M., Wednesday, May 19th.

The meeting of the Board of Directors will be held at 10 A.M., Tuesday, May 18th. The following are Directors: Messrs. A. W. Littleton, Geo. H. Harper, Peter Young, Wm. Steinwedell, O. O. Thwing, I. C. Copley, C. W. Blodget, H. W. Douglas, James Forbes.

The Grand Hotel has been selected as the headquarters for the members, and the sessions of the Association will be held in a suitable room contained therein. A rate of $3 per day, American plan, has been obtained; rooms with bath, extra. Those who desire cheaper rates can obtain them at the Palace Hotel, located on Vine and Sixth streets; rates, $2 to $2.50 per day; or at the Hotel Emery, European plan only, rooms, $1, $1.25 and $2 per day. It is advisable that all write and reserve their rooms in advance of the meeting.

The Executive Committee have arranged for the presentation of the following papers:

"Revivification of Oxide of Iron in Purifiers," by Mr. I. C. Baxter, Detroit, Mich.

"The Failure of the Commercial Attempts to Supply Fuel Gas in the United States," by Mr. F. H. Shelton, Chicago, Ills.

"Selling Gas," by Mr. I. C. Copley, Aurora, Ills.

"Leakage," by Mr. E. H. Jenkins, Covington, Ky.

"An Oil-Tar Separator and Its Results," by Mr. John R. Lynn, Detroit, Mich.

"The Welsbach Incandescent Gas Light for Utility and Economy in Street Lighting," by Mr. H. Wilkiemeyer, Evansville, Ind.

"Wrinkle Department," edited by Mr. Geo. Treadway Thompson, New York.

Mr. F. Egner, who is now in Europe investigating inclined retorts, or "slopers," will send a communication giving the results of his investigations.

The Central Passenger Association, Trunk Line, Southern Passenger Association, and the Chicago and Alton, from all points in Illinois, have granted rates of 1½ fare for the round trip, conditional on 100 certificates being presented to the Secretary for indorsement. The territory embraced by the above Associations includes all States east of the Mississippi river, except New England, and Wisconsin.

All persons attending the meeting will purchase a first-class ticket at starting point, paying full fare for same, obtaining from agent a certificate stating that the person whose signature appears on same has purchased at full tariff fare one first-class ticket to Cincinnati, which certificate, after it has been signed by the Secretary of the Association and a representative of the above Passenger Associations, will entitle the purchaser thereof to a one-third rate returning home.

All persons obtaining reduced rates must apply to agent at least 30 minutes before departure of train. All station agents do not have a supply of certificates, but they may be obtained by request, if notification is made in time. Persons outside the territory embraced by Passenger Associations mentioned above should purchase a ticket to nearest

point within said Association, and from there purchase a ticket to Cincinnati, obtaining a certificate which will entitle them to a one-third fare returning to place from which certificate was obtained.

All queries sent to the Secretary for the Question Box will be assigned to members for answers.

A cordial invitation is extended to members of other Associations to meet with us, and to participate in the discussions of papers presented.

The Secretary will be pleased to answer any communications pertaining to the meeting, and will mail blank applications to any who desire to become members of the Association.

JAMES W. DUNBAR, Secretary.

BRIEFLY TOLD.

CAN THE GAS ENGINE BUILDERS BE TRUSTED TO MANAGE THEIR BUSINESS?—It is a queer fact—undoubtedly a fact, for it is so often in evidence—that people in certain lines of business have the belief that other people in certain other lines of business do not carry on their trade to the best advantage. Indeed, some of the first part hold the conviction that were they conducting the business of some or all of those to the second part, the business of the second part would be vastly better carried on. Of course, the practical solution of this is quite easy of accomplishment, since the field is open for the party of the first part to occupy it as the party of the second part; and the test of time can be safely trusted to determine whether the change of base was wisely made. All this is preliminary to the remark that the contention raised by a contemporary of ours over the way in which the gas engine business is conducted in America is to be regretted. The charge was squarely made that the manufacturers of gas engines in America conduct their business on a basis that is neither modern nor logical; and the queerness of the charge was further accentuated by the evident personal tone that pervaded it. That the gas engine makers do not expend much money in advertising (the Otto Gas Engine Works, however, affords a notable example to the contrary) is amply attested by the paucity of such cards in our columns; still we do not hold that that failure is one or any cause forcing us to declare that the gas engine builders are incompetent to direct their trade in their own way. Nor do we think that Mr. Lloyd's letter, in respect of our contemporary's attack on the paper read by Mr. Lloyd at the meeting last winter in New York of the Ohio Association, calls for the comment made thereon, by Mr. S. M. Highlands, in our current issue. Of course, opinions held by thinking men are bound to differ, but it is equally certain that, however far such opinions may be apart, no added strength comes to them through expressing them in words and tone that indicate the personal rather than the judicial order. To our mind, the gas engine builders of America have made rapid strides in perfecting those machines, especially in the last five years, and those who fear that the makers thereof cannot be trusted to manage their end of the business should, at least from our point of view, devote their efforts to assisting the cause of gas engine advancement by temperate criticism—if criticise they must—rather than retard that cause by venting loose or immoderate complaint.

THE "WRINKLE" AND "EXPERIENCE" DEPARTMENTS OF THE PACIFIC COAST GAS ASSOCIATION.—Mr. M. C. Osborn, in charge of the Wrinkle Department of the Pacific Coast Gas Association, calls our attention to the fact that it is not too early for the members to be up and doing in the wrinkle line, if that department is to be up to the usual standard, for the Coast meeting next July. He asks that the wrinkles be forwarded to him, in any number (the more the better), at his address, No. 935 Sixth street, San Diego, Cal. A like line of advice goes in respect of the Coast Association's "Experience Department," the narration of which matters should be forwarded to Mr. John Clements, at Red Bluff, Cal.

NOTES.—Mr. Thomas N. Mordue has agreed to represent Messrs. Althouse & Kennedy, of Philadelphia, Pa., for the sale of their gas coals and cannels in New York and New England. Mr. Mordue's headquarters are in No. 1 Broadway, N.Y.——The fraternity will no doubt join us in hearty congratulations to Mr. E. S. T. Kennedy, of the Hazelton Boiler Company, of this city, over his marriage (April 28) to Miss Mary Augusta Cross, of Montclair, N. J.——The Paris (Tex.) Electric, Light and Railway Company (also in control of the local gas works), has gone into a Receiver's hands. Mr. John A. Porter is the Receiver.——The officers elected at the meeting of the Texas Gas and Electric Light Association were: President, L. T. Fuller, of Calvert; Vice-President, J. C. Lord, of Fort Worth; Secretary, W. E. Holmes, of Austin; Treasurer, Fred. Fries, of San Antonio.——There is much talk of an opposition Company for Denver, Col., the project to use the mains of the steam heating company seemingly having been revived.

[Prepared for the JOURNAL.]

Locating, Determining and Laying of Street Mains and the Distribution of Gas.

By MR. J. P. GILL.

The proper distribution of gas, starting from the gas company's holder or holders, and reaching the consumers is, it is not necessary to prove, of the first importance, next to the operations of the retort and purifying houses. It being more or less complicated in character, experience and careful investigation are required preliminary to the commencement of work on the mains. One who has had a large experience will more readily grasp the situation and see what is required to be done, at least approximately, than one new to the business. The practical man, however well he may be acquainted with daily routine, will often make a rough guess and jump at conclusions which are not warranted by theory and related science; the consequence necessarily being present expense and subsequent trouble and loss. To make a satisfactory estimate, a knowledge of the elements entering into the calculation are requisite, which are more or less complex and sometimes difficult to ascertain with exactness, but are nevertheless as essential as the details of any business or work.

The probable immediate consumption at different points or districts in a town or city, the distances and the probable increase in the number of consumers during the course of some years having been ascertained, there remain to be estimated the sizes and lengths of the pipes, the pressures, both initial and at the beginning of different consecutive lengths of pipe, and those at any given locality and at terminal points, with a view to economy of construction and to satisfactory and economical distribution of gas. The proper grading of the pipes is also important, that a greater number of drips may not be set than are really needed, and which shall give ample drainage to avoid traps and accumulations of deposits which tend to obstruct the flow of the gas.

In a small town these details may be worked out with ease before a pipe is laid, but in large towns and cities they cannot well be foreseen but must be left, in a certain measure, until unforeseen difficulties and obstacles are encountered, to provide for and overcome which will call for continuous observation and forethought. This practical work should not, however, supersede the original investigation and calculations, since if these are neglected there will be continual mistakes, trouble and expense, not only when the pipes are being laid but subsequently during the running of the works. It is not the first judicious cost of a plant, even if it is in excess of the original estimate, which is objectionable and to be especially guarded against, but the after increased expense in the prosecution of the work, caused by faulty planning and construction. This avoidable and increasing expense continues to accumulate month by month and year by year, and may, in the course of time, amount to the first cost of the works and, therefore, may be regarded as so much lost and buried profits. These extra running expenses have one or both of the following effects, namely: To add to the cost of gas manufactured, keeping the selling price higher than necessary and thereby retarding an increase in the consumption of the gas; or, on the other hand, preventing the stockholders from receiving the dividends which, under proper work and conditions, they might rightfully have anticipated.

In illustration, suppose in order to do a piece of constructive work as it should be done, it should cost, say $500 more than the estimate, and suppose the make of gas to be on the average 500,000 cubic feet per day, or 182,500,000 cubic feet per year; and also suppose that the extra cost of manufacture, repairs and alterations, leakages, loss of consumption, supervision, etc., should be 1 cent per 1,000 cubic feet, which it might easily amount to and much more, it would make a yearly loss of $1,825, or three and-a-half times more than the extra first cost of the construction, it being also remembered that the expense of construction ends when paid. The running expenses, however, may be said to never end but continually accumulate, emphatically so in the case of unnecessary and avoidable expenses, caused by defective construction.

The leakage caused by bad joints, made when the pipes are being laid, may neutralize many times over any possible saving in the *production* account, and may seriously affect the dividend account. A circumstance confirmatory of this statement occurred some years ago, in a city of 125,000 inhabitants, having an average daily consumption of about 300,000 cubic feet. The leakage in the street mains was so large that the payment of dividends out of the profits was impossible, which condition would undoubtedly have continued had not steps been taken, under a new supervision, to stop this loss of gas. Excavations were made uncovering 20 miles of mains and all the joints examined. In this entire distance, there were not found five sound joints. Some

leaked a little, others more, and others very badly. Some joints were found with only the hemp packing in them, having no lead whatever. In some localities, broken pipes were found, 4, 6 and 10 inches in diameter, which had been laid presumably on made or refilled ground, or with insufficient blocking. After these repairs were finished, the saving effected became immediately apparent by the profits in the shape of cash on hand and dividends paid.

There are various disturbing causes which check the flow of the gas and cause a smaller delivery than would take place if such interferences did not exist. All causes which tend to produce eddies or disturbances of the particles of the fluid amongst themselves will inevitably retard the flow and diminish the discharge. For this reason, sharp bends, contractions and enlargements, all irregularities on the interior surface of the pipes, flat surfaces against which the particles of gas may impinge, and all depressions which would allow of the accumulation of condensed vapors should be, as a matter of course, scrupulously avoided.

Among these disturbing causes is what is called the "contracted vein," which is simply the crowding together and consequent contraction of the outflowing current by the horizontal current in the delivering tank or pipe.

In Fig 1, *c d* is the diameter of the "contracted vein" or "vena contractor," and *a b* the diameter of the opening or smaller pipe. In Fig. 2, *C D* is the diameter of the smaller pipe and is equal to *a b* in Fig. 1. *A B C D* is a conical adjutage or connecting pipe, having the same shape as *a b c d*, the contracted vein. The quantity of a fluid passing at *c d*, the diameter of the contracted vein, is equal to that passing through a circular opening, with the diameter *d* and the pressure *p* at that point. With the conical ajutage *A B C D*, the quantity passing at *C D* is equal to that passing through a circular opening *C D* or *a b*, with the pressure at *C D*. The quantity passing at *C D* is to that at *a b* as 3 to 2, although the diameters are equal. If the pipe *a b c d* be sufficiently long to make a loss of pressure by friction, the contracted vein will gradually expand and fill the pipe, but the quantity will not be increased but diminished, because of the loss of pressure at *c d* caused by the back pressure.

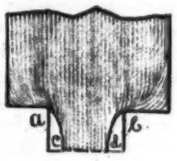


Fig. 1.

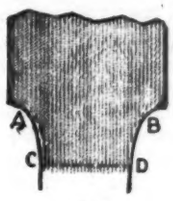


Fig. 2.

The frequency of the remark that the contracted vein has no effect on the flow of the gas because of its volatile nature, is the occasion of this reference to the subject; the fact or law being overlooked by those of that opinion that the molecules of all fluids as well as masses of matter have a tendency to move in straight lines and will react from all surfaces or objects against which they may impinge, and are alike governed by the same general laws and will be resisted or diverted from their course by opposing and interfering forces or objects. Clegg remarks that this deficiency in the flow may be disregarded when the length of the pipe is large in proportion to its diameter. This, in a measure, is true in the case of a single line of pipe, but where, as in the system of gas mains, there are a large number of pipes leading from others by means of crosses, tees and reducers, the aggregate effect is considerable. It would, for that reason, be much better to make the connection between pipes of different diameters with conical reducing pieces (Fig. 3), and not with so-called reducers made with right angles

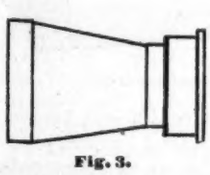


Fig. 3.

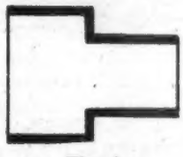


Fig. 4.

(Fig. 4), which are worse in their influence than an opening in the side of a tank, because of the impingement on the flat surfaces in the former, against which the flowing gas comes in contact, with the consequent recoil and contraction. The crosses and tees should, therefore, be cast with curved corners or junctions, and not with right angles. (Figs. 5 and 6.)

Another disturbing cause is the vacancy made and flat surface exposed in the joints when a pipe is turned from a continuous straight line, as when curving round, under or over obstructions, or from change of grade or direction. These, if numerous, which is likely to

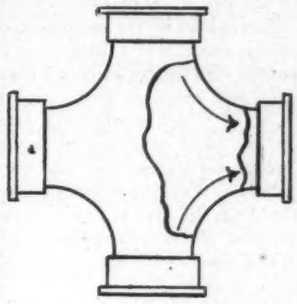


Fig. 5.

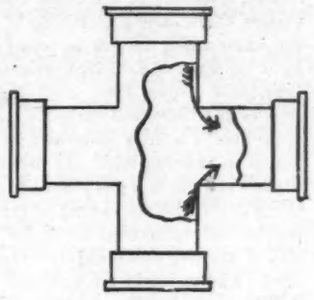


Fig. 6.

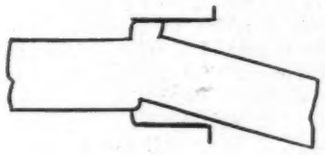


Fig. 7.

be the case, create eddies and resistances which seriously affect the flow and discharge of the gas. (Fig. 7.) All these obstructions fall practically under the general head of friction.

A few words seem desirable in reference to the grading of the pipes when being laid. Clegg gives 1 inch in 8½ feet for a proper descent. Competent engineers have used ¼ of an inch in 10 feet, or 1 inch in 12 feet. One inch in 12 feet is, therefore, the smallest grade that should be given to the mains. This is required both for an easy flow of the condensed tarry and other vapors in the gas, and to permit the liquid to flow round the iron which falls in the mains when they are tapped for service pipes, and also, as a very important matter, to allow for some settling in the pipes. One author gives a grade of ⅛ of an inch in 10 feet. This is practically a level and of no value, as it does not permit the flow of gas water on the bottom of the cast iron pipes, and any setting would make a series of traps, some of them very bad ones. No pipe continues in exactly the same position that it had when first laid, except it be on rock, or bedded for its whole length on solid earth which has not been disturbed by the pick or shovel, or on suitable and sufficient blocking resting on the natural undisturbed earth and placed not more than 3 feet apart from center to center. The pipe evidently should not be laid on earth that has been excavated and returned to the trench, no matter how well it may have been rammed down. No fresh filling can be so rammed by a workman that it will not settle in the course of time, particularly when it has on it the weight of the pipe and that of the earth filled in over it. Instances occur similar to the following: A ditch was excavated 1½ feet too deep, owing to an obstruction which was *afterward* discovered, and too late to prevent the mischief, but which should have been previously known to the contractor or the company, it does not matter which, so long as the defective work was allowed to pass. The earth was filled in and rammed for that depth for about 100 feet in length, and the pipe was laid upon it. That pipe was as sure to settle as the sun to rise. No filling can be sufficiently rammed without the aid of water, that is, without having been well puddled, the earth being then allowed to settle and become dry. In other instances, some 12-inch pipes were accidentally found to be nearly half full of water, and 4-inch pipes, for nearly 150 feet in length, to be so nearly full that very little gas passed through them. Both pipes had been laid for several years and had been gradually settling. As another case in point, some newly laid 4-inch pipes were found to have a trap of 1½ inches. These are a few out of the many instances of the kind that are known or unknown, and show the conscientious care that should be exercised when laying the mains.

It is the practice of some parties to rest pipes 12 feet long on only one

blocking, placed near the hub ends, and those blockings frequently not good and reliable ones; the earth is then filled in and tamped under the pipes with a view to give additional support to them, thus leaving 12 feet of fresh earth under each 12 feet of pipe, as if, were the pipes lifted up, the same tamped earth could not be rammed down several inches. Hence, a settling of the pipes, traps for the accumulation of condensed vapors, oftentimes a flickering of the lights caused by the oscillation of the water when the gas is passing rapidly, sometimes a deficiency of light for want of sufficient pressure, trouble with the consumers, breakages, loss of gas, both from that cause and impaired joints, cost of repairs and increased current expenses, all of which would have been prevented if a little judgment and care had been exercised when the mains were being laid. As the street mains are an essential and very expensive part of a gas plant, it would seem as if everyone having anything to do with the laying of them would use the utmost care to make perfect and permanent work, for the purpose of preventing loss of gas and of keeping down current expenses and cost of repairs to the lowest limits, and to retain the goodwill of the consumers.

It may not be deemed amiss to say that cast iron pipes, when received from the manufacturer should be examined and proved, to make sure that they are perfectly sound, having no cracks in them and no honeycombs or other flaws, and are entirely free from curves in any part of their length. Such tests may be made with compressed air, but far better with water forced into the pipes under a high pressure. The water will appear on the outer surface and show where the defects, if any, exist. The water should be of the same, or higher, temperature as the air, because, if colder, the condensed moisture from the air might deceive the examiner. Curved or bent pipes require a steeper grade than straight ones to overcome that defect, that there may be no depressions; the additional excavation and care required add to the cost and difficulty of laying them. An imperfect, porous casting increases the leakage, it being well known that gas will pass even through the pores of sound pipes. An efficient superintendent will attend to all these details and will be worth to the company employing him many times the value of his salary.

After these preliminary remarks, which have been made of a practical character, and the importance of which, in their several degrees, it is thought, will be recognized, the next subject to be considered will be the exploration, survey or prospectus of the town or city in which it is proposed to build a gas works; having more especial reference to the number of consumers, consumption of gas and the sizes, lengths and location of the street mains. It is assumed that a suitable lot upon which to erect the works, having regard to location and price, has been selected, the location being as near as possible to the district or part of the town having the greatest consumption, for the sake of economy in the cost of laying the mains, and of delivery of gas.

A rapid personal survey can be made by walking or driving through the town, and a rough estimate be formed of the length of pipe necessary to be laid, and also the probable yearly consumption, which may be verified by information obtained from some of the citizens, particularly those who are interested in the project. For the purpose of the present inquiry that which is important to be ascertained is the probable largest daily winter consumption, including the gas required for heating and cooking as well as for light, with an estimated yearly increase. The works being large enough to supply the greatest demand, ample provision will have been made for a less consumption.

The town should then be divided into districts, according to the description and number of the population, the kind and number of the buildings, and whether stores, residences or manufactories are the principal features, and the size and character of each. A map should then be made of the town with the streets laid out on it, with the districts designated as determined upon, with the ascertained probable amount of consumption in each. It is presumable that the municipality has a map already prepared; or, if not, that a surveyor may be procured who would make such a drawing. If there should be neither, a map may be readily prepared by measuring along the middle of each street or highway between the intersections of all crossing streets, and the distance between such intersections recorded, with such other items as may be thought desirable. If the scale is sufficiently large, the distances of the pipes from the curbs or sides of the streets may be given in figures, thus forming a picture of the exact location of the mains. This will greatly facilitate the finding of them at any future time, at any point whatever and for any purpose required.

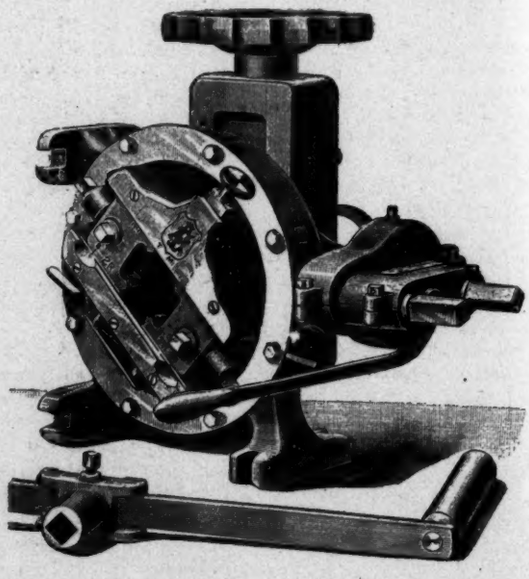
In connection with this map showing a plan of the network of the mains, with the location of the drips, it is not only desirable but of much importance that there should be profile maps of each and every street showing the rise and fall of the surface of the ground, or, in other words, the elevations of prominent points, such as those at changes of grade and at the junction of intersecting streets. These profiles will give the levels or elevations of points on the surface immediately over the pipes when laid, wherever elevations of the latter are taken. On these profile maps the street mains are to be plotted, showing at a glance their grades and their depth below the surface, including all crosses, tees and other fittings, drips set and all *changes of grade*.

For want of such profile drawings many serious errors have been made, not only in gas but in water pipes and in sewers; such as unnecessarily numerous drips, wrong grades, erroneous changes of grades, traps, etc. These records will enable the engineer or superintendent of the company to easily ascertain, by taking a few levels, if any settling of the pipe has occurred and to what extent. He will thus have it in his power to discover the source of any trouble with the consumers lights, or insufficient flow of gas, and the cause of any irregularities in the appearance, or doubtful appearance, of the pipes, and if there has been any interference with them by other parties.

(To be Continued.)

The Armstrong Improved Pipe Threading Machine.

The new No. 0 pipe threading machine made by the Armstrong Mfg. Company of Bridgeport, Conn., will thread from ¼ to 2-inch pipe. It uses the regular Armstrong adjustable dies, which are put in the machine and adjusted in the same manner as in the hand stock. The dies can be opened after cutting a thread, and when the pipe is removed may be locked back to the standard size without resetting. This is accomplished by an automatic locking device which is operated by simply pulling a knob. The dies, however, can be adjusted to the variations of the fittings, the same as in the stock. All the gears and moving parts of the machine are run in oil, being inclosed in a chamber which covers and protects them from chips and dust. The die head has no teeth on the part where it fits into the shell and forms a bearing, in this way preserving its bearing surface and making it impossible to get loose. In addition to the die carrying head forming a bearing in the manner shown, it has an inner journal, thereby increasing its wearing surface. A powerful self-centering vise, which exerts its power from the center of the jaws and not on the side, is used with this machine, and will hold the pipe being threaded with a light pressure of the wheel. The construction of the machine admits of its being adjusted to a post on the side of a building, or on a bench. Another, and one



The Armstrong Pipe Threading Machine.

of the principal features of this machine, is that it has two speeds, a change from one to the other being effected by merely removing the crank from one spindle to the other. In one case the operator can cut from ¼ to 1-inch pipe, inclusive, with great rapidity; then by changing the crank to the other speed from 1¼ to 2-inch, inclusive. This avoids the necessity of turning a great number of times on small size pipe.

To operate the machine, the vise is pushed back and the pipe located

in the mouth of the dies, then by pressing the feed lever and turning the crank the pipe is fed into the dies. When the pipe is flush with the dies the small lever shown on the under side of the die head is pressed toward the die, which releases the locking device, and by pushing the knob on the opposite side the dies are thrown open. If the vise with the pipe is then pushed back and the knob pulled out, the dies are reset ready for threading another piece of pipe. The locking device adjusts itself automatically.

As this machine uses the regular adjustable dies, it can be furnished with dies for threading pipe from ⅛ to 2-inch, either right or left, or with bolt dies for threading from ¼ to 1¼-inch rod, inclusive, also with dies for threading brass tubing.

Dissimilar Action of Similar Machines.

[By Mr. Wm. Baxter, Jr., in *Electrical World.*]

There are many men whose mental tendencies are such that they derive an enormous amount of pleasure from the contemplation of any scientific subject in the light of an inexplicable mystery. Such men are not confined to those who have derived their knowledge from practical experience exclusively, but include many who are thoroughly familiar with the highest grade of technical literature, with all the fundamental laws of nature and with all the theories, accepted or unaccepted, in relation thereto. Many of these men know that the position they take in endeavoring to shroud in mystery any particular action that is not at all obscure is not tenable, and they will not pretend to assert that it is, but for all that an unconquerable desire compels them to say that it can only be regarded as one of those things that cannot be accounted for.

All this marveling over these assumed incomprehensible caprices of nature is brought about by our unwillingness to accept as real conditions that have no actual existence. Our present knowledge of the laws of nature is sufficient to enable us to say without qualification that if two machines are identical in every respect, their action will be the same in every respect when under similar conditions; and the fact that the operation of the two is not the same is a positive proof that there is a lack of similarity in their construction. In addition to this it is not difficult to show that to make two machines exact duplicates of each other is a practical impossibility, and therefore dissimilarity of action is not an inexplicable mystery, but on the contrary the unavoidable result of the conditions that actually prevail. The magnitude of the difference in the action of two machines really serves as an index by which to gauge the accuracy of their construction, and the difference can never become zero unless perfection is attained.

If we consider the causes which interfere with obtaining uniformity of action, we will find that they are very numerous and that some are practically beyond the control of the manufacturer. As an illustration, consider the case of two railway motors; it will be found that there can be electrical, magnetic and mechanical differences. The electrical differences cannot have any great effect upon the operation, in fact, not great enough under ordinary conditions to cause a difference sufficient to be detected by the ordinary methods of testing. The magnetic differences, however, can be formidable and so can the mechanical, and what is more, they will be such unless the greatest care is exercised in the process of manufacture.

In separating the causes of difference in action according to the foregoing classification, an arbitrary method must necessarily be followed, and the determination of the heading under which to place any particular cause, will depend wholly upon the point of view from which the classification is made; this point of view in the present case is taken with reference to the constructive features.

Under the electrical heading we can place the difference in the resistance of the wire, which may be due to inequality in length, or in diameter, and also to a difference in conductivity. The length of wire in the two armatures will be practically the same, although not actually so, but in the field coils there is more room for discrepancy. In the diameter the variation as demonstrated by practice is very slight, and seldom enough to be noticeable. The difference in conductivity may be as much as 6 or 7 per cent., but ordinarily is not over 1 or 2 per cent. There is another way in which the electrical similarity may be destroyed, and that is in the number of turns of wire; these will be the same as the two armatures, but in the field coils may differ as much as 1 or 2 per cent., hence on this account the magnetic flux may be affected. The total difference in the electrical resistance of the motors may, in extreme cases, be as much as 6 or 7 per cent., but in 90 cases out of 100 it will not be over 2 or 3, and as this is at the most only 8 or 10 per cent. of the total resistance opposed to the E.M.F. of the operating current, the effect upon the action of the motors cannot be over two-thirds of 1 per cent., and in the great majority of cases not over one-quarter of 1 per cent. The difference in the number of turns on the fields cannot affect the flux by more than a fraction of 1 per cent., therefore the total inequality due to the electrical differences cannot be so great as to be measured with certainty by the instruments generally used for testing motors of that size.

Under the magnetic heading will be considered only the magnetic properties of the metal constituting the magnetic circuit. It is generally supposed that if the permeability is not very high the results will be very poor, and writers upon the subject of electrical machinery design invariably state that only the very finest grade of charcoal iron should be used. This would be very good advice if it could only be followed, but those who have had experience in the manufacturing line know that 99 per cent. of all the charcoal iron in the market at the present time is steel. Sheet iron is practically a thing of the past, and although a small amount of it is made and may find its way into the armatures of motors and generators, by far the greatest number of these are made of steel, which may possibly possess the property of giving better results when known by another name.

The difference in the results obtained by using different qualities of the same metal, in apparatus having a closed ferro magnetic circuit, is very decided, but it is not necessarily so with motors and generators; the use of a different metal will, however, greatly affect the output of the latter machines. If the field in one case is made of cast iron, and in the other of steel, the capacities will be in the ratio of about two to one. There are many men who believe that the only difference between cast iron and steel or wrought iron is that the latter requires less magnetizing force to develop a given flux, and, therefore, that the former can be made to do just as much by simply placing more wire upon the field. This is an erroneous notion that has led many into serious mistakes. A density of, say, 14,000 lines per square centimeter can be obtained in steel or iron with about 20 to 25 ampere turns to the centimeter of length, but the same density in cast iron is almost beyond practical limits.

The difference between wrought iron and steel of different grades is principally that they require more or less magnetizing force to develop a given flux, but the highest practically attainable density is very nearly the same, whether the quality is good or bad.

The armature is the part that suffers the most by the use of an inferior grade of metal, and this is due to the fact that the hysteresis loss is materially increased. This raises the temperature and as a result reduces the current carrying capacity of the wire, and therefore the output. Making the field of low grade iron or steel will tend to reduce the flux density, but unless the air gap is very short, and the magnetic circuit very long, it will not have a very noticeable effect upon the actual strength of the field, as will be shown in the consideration of the mechanical causes of difference.

Some years ago the writer experimented with different grades of armature iron, as it is called, or more properly sheet steel, to determine what relation the results obtained with the various grades bore to the difference in price. The test was made by constructing two armatures, one of the highest grade of metal, and the other of the cheapest stove pipe iron obtainable. The armatures were placed in fields as nearly alike as possible, and after the first results were noted, were exchanged, so as to get the behavior of both in each field. The results were such as to show that there was a difference in the operation of the two armatures, but it was not enough to be measured with certainty. The difference in the temperature, however, was so great as to materially reduce the amount of current that could be carried without danger of overheating, thus reducing the maximum capacity of the motor.

Steel is almost universally used at the present time for the fields. It is of remarkable uniformity if always obtained from the same foundry, so much so that the output of the machine cannot be greatly affected by the slight variations in its qualities, although sometimes there is a sufficient lack of uniformity in the density to cause a decided increase in sparking. It will be the case when hard spots upon the pole pieces interfere with the normal distribution of the flux over the surface. If it were as difficult to obtain a fair degree of uniformity in the magnetic qualities of iron or steel as is often supposed to be the case, it would be practically impossible to predict the result obtainable with any machine, but fortunately the difference between high and low grades of iron and steel is not so great as to interfere seriously with the results.

In the majority of machines there is perhaps no one cause that will affect the capacity more than a difference in the width of the air gap, but this difference is more under the control of the manufacturer than any of those already considered, as it is dependent wholly upon accu-

rate workmanship. As is evident, it is a mechanical difference, which can be reduced to a minimum, if a proper effort is made, but as it can have a greater effect upon the capacity of the machine than anything else, we are justified in assuming that difference in capacity is generally an index of the quality of workmanship. Lack of accuracy in this direction will produce more serious differences than electrical or magnetic inequalities, not only because the defect can be greater but also because the inequalities of an electrical and magnetic character can neutralize each other to a considerable extent.

To show what a difference in the length of the air gap may amount to it is only necessary to call attention to the fact that at the ordinary degree of density used in well-designed machines the permeability of the iron part of the circuit is from 500 to 1,000 times that of air, and as the total length of the circuit is anywhere from 50 to 200 or 300 times the length of the gap, it follows that the latter constitutes the principal part of the resistance. It is also on this account that differences in permeability do not produce any noticeable changes in the total flux. As an illustration, suppose that the flux density is such that the permeabilities of the air gap and the balance of the circuit are in the relation of 1 to 600 and that the air gap is ¼-inch in length, while the length of the circuit is 50 inches, then of the total magnetizing force the gap would require six-sevenths. From this it will be seen that a defect in the iron will only affect one-seventh of the resistance in the circuit, but in the air gap it will affect nearly the entire circuit. This also explains why an inferior grade of iron in the armature has but little effect upon the output, while it greatly increases the temperature. It is sometimes supposed that if the armature heats up considerably the capacity and the efficiency will be greatly reduced. This, however, is only true with respect to the latter. It can easily be seen that as the loss in the armature under ordinary conditions is only 4 or 5 per cent. all told, an increase of 1 per cent. will be noticeable, and 2 per cent. decidedly so, but as it will increase the amount of heat generated by 20 to 40 per cent., it would only affect the output of the machine by an amount too small to be detected, and if the wire were of sufficient size to carry the maximum current in addition to the increased amount of heat generated by the inferior grade of iron, the effect upon the output would not be noticed unless the machine were run considerably overloaded. A change in the air gap introduces a disturbance that affects nearly the whole circuit, and the result is that the flux is increased or decreased, almost in direct proportion with the variation in the length of the gap, and therefore the operation of the machine is affected in a similar ratio.

From the foregoing it will be seen that a difference in the conductivity of the wire, or its diameter or length or a difference in the permeability of the iron in the magnetic circuit, will affect the efficiency to a noticeable extent, but will not produce any material change in the capacity. A difference in the length of the air gap, however, will affect the capacity as well as the efficiency. In the case of a motor, an increase in the length of the air gap will cause a decrease in the counter E.M.F. and therefore an increase in speed. The inequality of two motors is more noticeable when they are connected in parallel than when running singly, owing to the fact that one acts against the other, and thus the defect is magnified. This is particularly the case if all the terminals of fields and armatures are connected in parallel, for then while the current will divide between the fields in proportion to their respective resistances, it will divide between the armatures in proportion to their counter E.M.F's. When each motor is in a separate circuit from end to end if the current through the armature tends to increase by reason of the lower counter E.M.F., the same increase is experienced in the field and as a result the latter is strengthened and the induction raised, thus checking the further increase in current.

The conditions considered up to this point will affect the efficiency, the capacity and the temperature of the machines, but it very often happens that the difference in these directions is not noticeable and the only inequality in a practical sense is the behavior at the brushes. Differences in this direction may be due to actual inequalities in construction, or to differences in the permeability of the metal in the pole pieces, but the latter is very seldom the cause. When a machine is in motion the density of the magnetic flux increases from the back to the forward edge of the pole pieces, and the machine being designed with due consideration to this fact, the brushes will not spark, but if through an unequal permeability of the metal in spots the uniformity of this increase is destroyed sparking will be the result. As a rule, however, the excessive sparking in one machine is due to differences in the construction of the commutator. If the copper of which the segments are made is of such hardness and texture that it will wear away at the same rate as the mica insulation, the surface of the commutator will preserve a true cylindrical shape, but if the metal is harder or softer than this the cylindrical shape will be destroyed. If the segments are harder they will wear with a hump in the middle, and a depression will be formed over the insulation. The brush will, under such conditions, chatter over the surface, and will, as it rides on to one hump, break contact with the preceding segment too soon, and thus cause a spark that will increase the difficulty by burning away the metal at the edges and thus increase the irregularity. If the metal is too soft the segment will be hollowed out, and as the brush rides up on an insulation it will break contact with the segment and cause sparks to pass between it and points on the surface of the segment some distance from the edge, and thus lower the surface still more. Whether the sparking is due to imperfections in the commutator or to difference in the structure of the pole pieces, can generally be determined by the effect of smoothing the commutator. If the trouble is with the poles, the sparking will be reduced temporarily, in consequence of the smoother surface, but if it is due to unequal wear of the commutator segments or insulation, the beneficial effects of the smoothing will be far more lasting, but not by any means permanent.

From the foregoing we can see that there are so many causes that tend to vary the actions of machines that the wonder is that they are so nearly uniform. If all the points in which a difference can exist could be made to act in one machine negatively and in another positively, the difference in the performance of the two might be 20 or 25 per cent., and possibly more, but such conditions never prevail. A difference that may be positive in one will be negative in another, therefore one neutralizes the other, and the actual difference between machines is equal to the difference between the sums of the actions. The dissimilarity of action that we would be made to believe is an incomprehensible mystery, as can be seen from the foregoing, is very far from being such, and the results that mystery-seekers assume should be obtained can only be realized by chance.

The Commercial Uses of Coal Gas.—No. II.[1]

By Mr. Thos. Fletcher, F.C.S., in the *Gas World*.

Gas Consumption.—Let me again clearly state that, once confidence is established and the results are known, the gas consumption is never questioned; it becomes a matter of indifference in every case, although, naturally, consumers object to waste. That it really is a matter of very secondary importance is easily shown. In most cases a workman can turn out more than double what he can with any other fuel, if the quality of the result is of any importance; and if he is put on piecework he can increase his wages 50 per cent., and leave a good margin of profit.

Take, as an example, the very common and very large industry of laundry work. An ironer, with irons heated by coal or coke stoves, is so handicapped that, at the prices paid for this work with gas-heated irons, she could not earn enough to keep body and soul together, doing at the same time very inferior work, with occasional scorching and damage. Any one who has watched the ironers in large factories, especially on heavy and wet work, would be astonished at the speed with which this is dealt with when gas irons are used with air under pressure. One person will do the work of three on the old system, she can earn double wages, and leave 50 per cent. profit for her employer. The same rule applies, to a greater or lesser extent, in all trades. Instances of this kind are constantly turning up. As I write, a report has come from a user of a furnace consuming 400 cubic feet of gas per hour. The work is satisfactory, and several more furnaces are wanted as quickly as possible. A customer who commences with a consumption of 400 cubic feet per hour, and is in a hurry to increase this largely, is a person worth consideration from the gasworks point of view. All that is needed is confidence in the results. Once this is obtained everything else is smooth and pleasant sailing; the old distrust and "higgling" are gone, and new and unknown consumers are in a hurry to increase their gas bills.

Japanners' Ovens.—Many thousands of these, heated by gas, have been in use for very long periods, but the cycle craze has recently caused them to spring up like mushrooms throughout the country. The rules, given already, for heating ovens apply to these, but there are several points on which intending users should be informed. The various stoving varnishes used require very different temperatures, ranging from 160° to 600° Fahr., and it is essential to know at what temperature the varnish gives the best result. As a rule, it may be taken that the higher the temperature required the more brittle is the varnish or enamel; and for cycle work, the lower the temperature

1. For No. I., see Journal, April 19, p. 596.

required the better the enamel stands the constant jar, without cracking or peeling off. The construction of these ovens, owing to their large size and lightness, is better done by a local tinsmith.

Lacquering Plates.—These are closely connected with japanning trades; in fact, except for flat work, a japanner's oven is preferable. Where a plate is used, the gas consumption averages about 2 cubic feet per hour for every square foot of plate heated.

Brazing.—This is a very wide subject, and an important one. Thousands of men are constantly employed on the work, using blowpipes consuming from 10 to 200 cubic feet of gas per hour each; and with so large a consumption economy is of importance. The first essential, on which this depends, is the use of air under a comparatively high pressure. From 1 to 1½ lbs. per square inch will be found the best working average for coal gas. Lower pressures give a more diffused heat, and do not concentrate it on the required spot, and, in addition to this, the temperature of the flame itself is lowered in proportion to the air pressure. With an air pressure of 1½ lb. per square inch, the gas supply from a ¾-inch, clear bore, pipe at normal day pressure will braze work about the size of an ordinary latch key or ¼-inch brass tubing; with a ½-inch gas supply, work up to the power required to braze a seam in 1-inch iron steam pipe; a ¾-inch supply will braze a strong flange on 1½-inch iron steam tubing. Of course, if the work is supported on a bed of broken coke, or surrounded by a non-conductor which retains and reverberates the heat, very much heavier work can be done with the same apparatus. It is important to bear in mind that doubling the air pressure does not double the power of any blowpipe. To obtain double the power four times the air pressure is necessary with the same blowpipe under the same conditions. The power can also be doubled by increasing the air jet to twice the area; but this simply gives a larger and more diffused flame, it does not increase the temperature obtained, and therefore large air jets are wasteful and objectionable for the sharp local heats usually required in blowpipe work. Where the object to be heated cannot be backed or protected to assist, it is much better to use two blowpipes on opposite sides of the work, rather than one of double the size and power, a shorter and quicker heat being obtained with the double arrangement. When blowpipes are used solely for annealing a lower pressure of air and a larger air jet are desirable, as a general heat without local intensity is necessary; and for this reason blowpipes for annealing, and those for brazing, require to be entirely different in construction, if economy and good work are to be considered. Important joints which have to stand very heavy strains should be brazed with an alloy of 11 parts of silver and 13 parts of copper. This stands strains and hammering to any extent, and can always be trusted for joints in steel, iron or copper.

Printers' Rollers.—These, unless made with the greatest care, rapidly wear uneven, and require to be recast. The slightest overheating causes bubbles, which are fatal to good work; and the vessel in which the material is melted must have a water jacket to insure slow and steady heating. This water jacket need only be on the bottom or, at most, half-way up the sides, and does not need to be over 1 inch in thickness, as a maximum. When the water jacket is warmed, 1 cubic foot of gas will melt 6 to 8 lbs. of composition. The iron moulds are best warmed by two long tube burners giving a perfectly equal heat the whole length. This is important, as the slightest irregularity is liable to produce rollers which wear unequally. In making the composition the gelatine or glue must be swelled first in cold water, then melted in the water jacketed vessel, and the glycerine added after it is perfectly melted. On the quality and hardness of the glue or gelatine used depend the wear and equal inking of the rollers.

Lithographic Printers' Stones.—For drying and warming these, in preparation for the transfer, it is universally admitted that a good source of radiant heat is essential; warmed air or hot chambers are not so satisfactory. A gas fire with a large surface, or, still better, one of the newer forms of radiant reflector stoves, will do all required perfectly. The advantage of the radiant reflector stove is that it can be used anywhere, without a flue, doing away with the necessity for carrying heavy and fragile stones from the machine to a fixed source of heat, which may be at a considerable distance from some of the machines.

Copperplate Printers (Pottery Work).—The plates for pottery printing are used warm, and are best heated on a smooth iron plate, with a few small atmospheric jets underneath. Trials for overglaze colors can be made in any muffle from which the products of combustion are excluded, and a form of muffle furnace is now made in which underglaze color work can be finished without the use of air under pressure. No ordinary gas muffle furnace will do this work properly, owing to the very high temperature required. Iron muffles will not stand the heat, plumbago or salamander reduce and destroy many of the colors, and fireclay is the only material suitable for ordinary use. These are very liable to crack, and all cracks must be repaired at once with a mixture of silicate of soda solution and ordinary fireclay, the surface of the crack being moistened with the silicate solution to insure adhesion. No drying is required after repairs of this kind, unless a thick mass of cement is used.

Tennessee's Coal Production.

From the advance sheets of the report of Commissioner of Labor and State Mine Inspector A. H. Wood, the production of coal in Tennessee in 1896 is shown to be the largest in the history of the industry, 2,663,714 short tons being produced, as compared with 2,319,720 tons produced during the previous year, showing an increase in production of 343,944 tons. The largest tonnage previously produced was 2,413,678 tons in 1891, which was 250,036 tons less than the production in 1896.

The production in 1895 and 1896 by counties, showing the increase and decrease, is given in the following table:

TABLE No. 1.—*Coal Production in Tennessee*, 1895 *and* 1896, *by Counties.*

County.	1895.	1896.	Increase.	Decrease.
Anderson	345,391	459,256	113,865	....
Campbell	324,289	378,063	53,774	....
Claiborne	147,122	200,002	52,880	....
Grundy	446,386	331,723	....	114,663
Hamilton	166,889	166.255	....	634
Marion	302,298	294,895	....	7,403
Morgan	61,665	218,843	157,178	....
Putnam	7,726	10,432	2,706	....
Rhea	140,852	97,490	....	43,362
Roane	129,423	169,255	39,832	....
Scott	112,178	175,209	63,031	....
White	123,334	146,166	22,832	....
Other counties and small mines	12,167	16,125	3,958	....
Total	2,319,720	2,663,714	510,056	166,062
Net increase	*a* 138,841	343,994	....	....

(*a.* Increase in 1896 over 1894.)

As will be seen from the above table, coal is produced on a commercial scale in 12 counties of the State. There are 64 commercial mines, employing a maximum of 6,556 men at the mines during the year, while the average number of days worked was 202.

The coal business, although the largest yet enjoyed by the operators in the State, was done in many instances at unsatisfactory prices. The margins, as a rule, were very small and were probably less than ever before obtained. The average selling price of coal in the State declined from 93 cents in 1895, which was the lowest figure previously reached, to 86 cents in 1896.

The total production of coke in 1896 was 332,746 short tons, showing a decrease of 39,001 tons over the previous year, when 371,747 tons were produced.

The production of 1895 and 1896, by counties, showing the increase and decrease, is given in the following table:

TABLE No. 2.—*Coke Produced in Tennessee*, 1895 *and* 1896.

County.	1895.	1896.	Increase.	Decrease.
Anderson	1,045	....	....	1,045
Campbell	8,000	3,500	....	4,500
Claiborne	22,036	28,479	6,443	....
Grundy	106,503	63,868	....	42,635
Hamilton	30,207	31,752	1,545	....
Marion	59,747	60,183	436	....
Rhea	72,001	50,623	....	21,378
Roane	63,639	82,608	18,969	....
Scott	8,569	11,733	3,164	....
Total	371,747	332,746	30,557	69,558
Net increase	*a*79,101	39,001	....	....

(*a.* Increase in 1895 over 1894.)

As will be seen from the above table, coke was produced on a commercial scale in eight counties. There were 14 establishments in operation, with a total of 1,929 ovens, of which 1,367 were in blast; 592,393 tons of coal were used in the manufacture of coke, of which 348,941 tons, or 58 per cent., were washed. The average yield was 56.7 per cent.

The tendency of the price of coke, like that of coal, has been downward. The average price in 1895 was $1.90, while in 1896 it was only $1.74. Notwithstanding this, the coke industry in the State is in a healthy condition, and the prospects are that the present year will show a largely increased production.

Much has been said and written about the Sewanee seam, which underlies the entire plateau, and is to Tennessee what the Pittsburgh seam is to Pennsylvania; and, although over 80 per cent. of the coke made in Tennessee at the present time is made from coal mined from the Sewanee seam, it is not by any means the only seam which produces good coking coal, as large quantities of good coke are being produced at Glen Mary, Mingo and Pioneer, all from different seams, while preparations are in progress looking to the erection of coking plants for coking the coal from the Coal Creek and Brushy Mountain seams.

No coke ovens have been built in the State since 1890, and it is undoubtedly an encouraging sign to note the addition of 250 ovens, which are being built, or reported for immediate construction.

The most notable feature of the coke industry in this State during the past year is the increased attention given to the treatment of coal used in coking. The reports show that 58 per cent. of the coal used in the manufacture of coke in Tennessee during 1896 was washed, whereas only 11 per cent. of the coal used in the manufacture of coke in 1890 was washed. The washing of coal in this State has now become a necessity, and every large plant in the State, except one, that produces furnace coke is equipped with a washing plant, and the following plants are proposed for construction during the year: Black Diamond Coal Company, 1; Brushy Mountain Mines, 1; Dayton Coal and Iron Company, 1 additional.

The most noticeable fact in this connection is that this condition, which did not exist five years ago, has been brought about by the demand from furnace men for a better and more economical fuel, which together with the improved methods adopted by Southern furnace operators, enabled them to make iron profitably at the decreased market price.

Stoppages in Ascension Pipes.[1]

By Mr. Norton H. Humphrys, Assoc. M. Inst. C.E., F.C.S.

The various correspondents who have replied to the question raised by a "Country Manager" do not appear to have appreciated the fact that the trouble is only experienced during the busy season, and that at other times the retorts work very well, which seems to indicate that certain unfavorable conditions obtain during the winter and at no other time. Without some direct acquaintance with the particular case in question, it is scarcely possible to do more than indicate in a general way some of the common causes of "chokes;" but the following considerations are offered in the hope that the propounder of the query, as well as others who experience similar difficulty—for I believe the trouble is a common one in small works—may find among them some hint or suggestion that may prove useful.

This subject is usually approached from one standpoint only—that of the condition of the apparatus; and the sufferer is advised to have larger dip pipes, to lift his hydraulic, or to make other structural alterations. But it is probable that methods of working, and the manner in which the retort house men discharge their duties, have much or more to do with the difficulty than defects in the design of the apparatus. There are several works throughout the country, having small dip pipes, hydraulic mains reposing on the brickwork of the settings, and perhaps no exhauster, and thus presenting a combination of all the circumstances, so far as design of apparatus is concerned, that are generally supposed to be favorable to choked pipes, but which in spite of all manage to get on very comfortably. While in other cases, notwithstanding every refinement of modern design, a great deal of difficulty is experienced.

I presume that a "Country Manager" has looked up some of the published matter on this much debated question—it would consume a fortnight's leisure to read the whole. At least a dozen papers and discussions respecting it will be found in the proceedings of our Gas Managers' Associations. It was before the British Association of Gas Managers in 1871, 1873, 1874 and 1881. The North of England Association tackled it in 1891, and the Southern Association in 1885; while the "late lamented" Southwest of England Association had it before them in 1884 and 1888. Our American brethren have had a great deal to say on the subject; and in France and Germany it has been as much a vexed question as in our own country.

1. In *Journal of Gas Lighting.*

When we glance down the advertisement columns of a newspaper or current magazine, and see the number of perfect cures that are advertised for almost every known disease, we wonder why folks continue to be ill or how doctors manage to get a living, when the remedy is to hand for 1s. 1½d. or 2s. 9d., as the case may be. And in a similar way, when looking over the literature above instanced—which includes not one but many "perfect cures" for the difficulty—we wonder how it is that, at this period, anyone should be driven into that pitiable state of distraction so feelingly described by a "Country Manager." To carry the medical simile a step farther, there was a shrewd old gentleman who used to say that he could prescribe rest and low diet for himself, whenever he needed it, without paying a doctor to do so; the inference being that the benefit afforded by such a mode of procedure was chiefly to be credited for the return to health, which is generally ascribed to the virtues of the medicine. And similarly, it may happen that when a gas engineer puts up some pet remedy—I will not say nostrum—of his own, and drops into the retort house to see how it is working some two or three times a day (or about twice as often as he was used to do), the mere fact of his more frequent presence induces a greater degree of care in such matters as attending to the furnaces, cleaning the flues, using the auger, apportioning the charges, and other little details that will be apparent to all who know anything of retort house work, that may of themselves contribute in no small degree towards the improved results for which the new contrivance takes the sole credit. How many inventions could be instanced, that gave wonderful results so long as they received special care and attention, but dropped into a very ordinary position so soon as this was withdrawn. So it is quite possible that more careful or regular supervision would of itself effect some improvement, without the help of any "patent" medicine. And I am the more inclined to attach importance to this suggestion, through knowing from experience that the retort house must of necessity go with less supervision in the busy season, though for several reasons it should have more. Just at this time the odd winter hands come in—some new at the work, and none inclined to be so careful of the interests of the concern as the regular all the-year round men, who have a constant job, which a wise manager will have arranged shall be worth a little more than they could get elsewhere in the district. Unless some care is taken, things are apt to get a bit slack all round, and the men think more about saving themselves trouble than of the comfort of the manager or the dividends of the shareholders. But with the advent of cold weather, the purifier house operations require daily supervision; while at the same time, all sorts of complaints arise in the distributing department. The manager is continually being called away elsewhere; while his clerk (if he has one) finds plenty to occupy his time in the weigh house and coke yard.

Let it now be assumed that a far-seeing directorate have provided a staff equal to dealing promptly and efficiently with the numerous demands that arise at the commencement of winter, and that the retort house operations are conducted throughout with reasonable skill and care. Under such circumstances, it is possible that trouble farther on may cause an inrush of stoppages in the ascension pipes. It is well known that any obstruction which baffles or hinders the free exit of the gas from the retort—such as tapering ascension pipes, small dip pipes or hydraulics, a heavy seal, or a seal in tar instead of liquor—is conducive to these troubles. So it may be that, as soon as a certain rate of production is reached, the current of gas is checked or throttled. The hydraulics themselves, the connections to the foul main, the condensers, or any place between the retort and the exhauster, may be so restricted in area as not to give free passage for the maximum make, though offering no obstruction during the summer and autumn. I have both known and heard of instances where trouble from chokes was always expected as soon as a certain make per day was reached; and also where it was always looked upon as indicating that a deposit of thick tar was accumulating at some point where experience indicated that it was to be expected. Increase of pressure in the purifiers is sometimes responsible for chokes. A systematic investigation with the pressure gauge will therefore often afford valuable information as to the cause, and will lead, not to "driving to distraction," but to some such simple remedy as clearing out a particular pipe, or running a supply of ammoniacal liquor (usually led from the rising pipe to the scrubber) into a certain length of hydraulic.

Another point that is worthy of consideration is as to the extent to which the methods adopted for clearing the obstruction are responsible for an early reproduction of the difficulty. Frequently it has been remarked that this is confined to particular pipes—perhaps one only out of a setting; the remainder being free. Now does it not happen, and especially so when the "distraction" period has been reached, that

every effort is directed to cleaning the pipe and getting it to work again with the utmost possible despatch. The lid is slacked, the top cap is taken off, red hot bars are introduced to burn a way through the obstruction, and it is encouraged in every way to burn itself out. In desperate cases, red hot coke is applied externally; or with a good draught a flame may be seen issuing from the top of the pipe, with the result that the mouthpiece and pipe become nearly red hot, and every vestige of soot is burned off the outside. As soon as possible the pipe is augered or scraped clean—this part of the work being done none too carefully; and the retort is immediately recharged and put to work, regardless of the fact that the conditions which all authorities agree are conducive to chokes, have been exactly produced. The retort has improved in temperature during its enforced idleness, and the mouthpiece and ascension are abnormally hot. The trouble is, therefore, more likely to reappear in the freshly cleaned pipe than in others.

A very general remedy is to use a heavy charge of small coal, or to place a shovel or two of wet small coal in the mouthpiece. It is both awkward and unpleasant to take off the offending pipe, and replace it with a new one; the readiness, or otherwise, with which this can be done depending on the arrangement of the joints, etc. Some forms of connection facilitate it; others do not. But when a pipe is plugged from end to end, and at the same time one is pressed for productive capacity, this is the quicker and better remedy to adopt, and will occasionally save a particular retort from getting a bad name.

In addition to this, there is a sort of sympathy between stoppages in the ascension pipes and accumulation of carbon in the retort; and the conditions which encouraged the one are also favorable to the other. Though it is not easy to find a theoretical explanation of the effect of a few inches of back pressure in promoting both chokes in the ascension and deposit of carbon in the retort, it is impossible to dispute the practical evidence that it is a very powerful factor. It is just where the pipes choke frequently that a deposit of carbon comes quickest, and therefore the shorter the intervals between the periods of standing off for cleaning. And at these times there is a reproduction of the conditions first mentioned. The lid is slacked, and the top cap removed, to facilitate the passage of a draught of air up the pipe; and though the primary object is to burn off the carbon in the retort, the current of air is also supposed to be beneficial by cleaning—*i. e.*, burning—off any pitchy or carbonaceous deposit in the mouthpiece and ascension pipe. We again have the production of an abnormally hot mouthpiece and ascension pipe, together with a higher temperature in the retort; and unless some additional means are adopted, the newly cleaned retort is more likely to choke than others. In fact, the conditions are aggravated as compared with those in the former case; for the removal of the carbon from the retort allows a freer convection of heat, and the charge is worked off more rapidly than before. It is a good plan to arrange that the first charge after cleaning should be not only heavier than usual, but allowed a shorter time. But we sometimes find that the first charge is left an hour or two over the usual period, so as to admit of bringing the retort into its accustomed order of working. The men, if left to themselves, will practice many little dodges that appear at first sight to promise a saving of trouble, but which really in the end have a contrary effect.

I have dwelt, with perhaps unnecessary detail, on these little everyday matters, as it is probable that "Country Manager" would prefer some method of working that would enable him to rub along with existing apparatus, rather than details of structural alterations that at best cannot be carried out for some months to come. But a few general considerations as to the environments and working of ascension pipes may not be out of place. Though the actual surroundings as regards temperature vary perhaps in every pipe, such variation is a matter of degree only. In every case, the pipe is subjected to several influences that tend to raise its temperature, both internally and externally. On the outside, there is heat convected from currents of hot air arising from the furnaces and from flame and smoke during the operations of drawing and charging the retort. There is also radiated heat from the front of the setting, or from adjacent pipes, mouthpieces or other surfaces hotter than itself. The body of the pipe receives heat conducted from the retort and furnace through the mouthpiece; and internally there is the heat derived from the large volume of gases and vapors escaping from the retort. This is exclusive of heat due to combustion of carbon, either in the retort or the pipe itself, which takes place during cleaning or scurfing the retorts. The causes that tend to lower its temperature are not so numerous—simply conduction to the hydraulic, convection due to currents of colder air, or radiation to bodies colder than itself.

Of these effects, the greatest variation probably takes place in the gases and vapors from the retort, which are largely affected, both as regards quality and quantity, by the conditions of working and the properties of the coal used. Sometimes we are told that larger dip pipes should be provided. Larger pipes may be of some practical advantage, as leaving a greater margin for deposits; but a pipe 4 inches in diameter, or even less, is quite equal to carrying away the products of distillation as fast as they are evolved. A charge of 3 cwt. of ordinary coal will give off products that eventually take the form of 1,500 to 1,600 cubic feet of purified gas, 1½ to 2 gallons of ammoniacal liquor, and about the same quantity of tar. The gas, at the temperature at which it leaves the retort, would represent a bulk nearer 3,000 cubic feet, the water vapor would represent something like 800 cubic feet, and the tar vapor considerably less, as its specific gravity is much heavier than that of steam. The products from one charge may amount to as much as 4,500 cubic feet in bulk, which would be spread over the five or six hours of the charge. Now, according to Newbigging, a short length of 4-inch pipe would pass this quantity in an hour, under a pressure of 1-tenth or so. Therefore there is no reason to suppose that, even with the freest working coal, the rapidity of production at any time rises to anything more than a 4-inch pipe can readily carry off; and this being so, where does the advantage of a 6-inch or a 5-inch dip pipe come in? It is a very common thing, when taking down a set of retort fittings after a season's work, to find accumulations of hard carbon in the ascension pipes, occupying half the area or more; and the pipes had evidently been worked for some time in that condition, but failed to afford any evidence of their condition. So it is not easy to see how a 6-inch dip should let the gas off with greater freedom than a 4-inch one would do.

Condensation begins immediately the gas quits the retort, and probably proceeds actively during the passage through the ascension; some of the products being deposited, and others carried forward mechanically. The degree of such condensation will be in proportion to the degree of cooling influence to which the pipe is exposed. It would seem that, as chokes are undoubtedly due to matter deposited from the gas, the way to reduce their liability to them is to reduce the condensation. But all the remedies that have yet been proposed may be divided into two classes. The smaller of these consists of roughly filtering the gas as it leaves the retort—to remove soot, dust, or other suspended matter—by the introduction of baffle plates or gratings in the mouthpiece; and the other, of cooling the ascension pipe by the application of water externally or internally, or of protecting it from radiated heat. Instead of checking condensation by keeping the pipe warm, they aim at encouraging such action by increasing the cooling influence; and of the two classes, they appear to have been by far the more successful, from which it would appear that very often the cause of a "choke" is not too much condensation, but just the reverse. The appliances which act as filters are always found to take up a considerable amount of dust and soot—in fact, the extra trouble required to keep them clean has been advanced as an objection to their use. From this it would appear that a certain quantity of finely-divided solid matter is carried forward from the retort to the ascension pipe. Being partly softened by the heat, or charged with tarry matter, it would soon form a ring round the lower part of the ascension. Condensed matters from the upper part, slowly trickling down, and being rendered more and more viscid by the vaporizing of their lighter constituents as they successfully reach warmer and warmer surfaces, find a lodgment here, and are retained and baked into hard coke or graphite. But supposing the condensation is increased by additional cooling influences. The deposit trickling down the interior of the ascension pipe will then not only be more abundant, but more liquid—sufficiently so not only to reach the mouthpiece itself, but also to carry solid particles with it. I take it that these choke-preventing devices act by conveying down into the mouthpiece the matters that, under other circumstances, would form chokes. Apparatus for effecting this result has the practical advantage of being cheap, easily applied to existing apparatus without stopping the make of gas, and as easily removed if found to be unsuitable.

If this explanation is correct, there is another way to obtain just the same result, which I have known to be successfully applied. A very general experience is that the shortest pipes give the most trouble. I sometimes think that the raising of the hydraulic two or three feet clear of the benches, which was put into practice some years ago, was a double-barrelled improvement. It not only placed the hydraulic itself out of reach of the heat from the settings, but it necessitated a corresponding elongation of the ascension pipes. Suppose we have an ascension pipe 9 feet long, in which troublesome deposits are apt to accumulate, either as hard carbon or, what is worse, that thick gluey mass that should make the fortune of a vendor of patent undetachable cement, with which all gas engineers become acquainted sooner or

later—and usually sooner; and that, without making other alteration, the pipe is lengthened to the extent of an additional 6 feet. This added part is exposed to a greater degree of cooling influences than the original; and there will not only be more condensation in it, but the deposited matter will be of a lighter and more fluid character. Is it not possible that this, trickling down upon the pitch, soot, dust, etc., in the lower part of the pipe, and slowly percolating the same, may carry the whole down into the mouthpiece in a soft pitchy condition? It has been observed that the interior of the ascension, when in proper action, should not be dry but moist; and that if from any cause it becomes dry, then accumulation of matter commences. Larger ascension pipes may to an extent secure the same result. By keeping the current of gases for a longer time in the pipe, they would encourage condensation.

And lastly, a word about the hydraulic main. If the gas is to get away freely, and with as little pulsatory action as possible, there must be a sufficient width on each side of the dip pipe at the surface of the liquid. There is not only room wanted for the free discharge from the particular pipe itself, but also to allow the free passage of the gas from other dip pipes towards the outlet. I think the old-fashioned cast ▭ hydraulics were deficient in this respect, and the circular ones were worse. Some of them were about 14 inches each way, and only left a space of about 24 square inches on each side of the dip, through which the gas from, perhaps, 20 or more retorts had to make its way while yet in a heated and expanded state. Even when the plan of breaking up the hydraulic into sections of 12 or 15 retorts on each was adopted, there was none too much room. The gas outlet should be in the center of each section, and not at one end. The surface width of the hydraulic should not be less than 18 inches; and it may with advantage be as much as 21 inches, as there are other points to be urged in favor of a wide hydraulic, apart from its allowing free exit from the retort.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, April 10th, 1897.

Carbureted Water Gas and Unsound Fittings.—A Parliamentary Question.—A Dictatorial Gas Consumer.—Gasholder Disaster at Middlesbrough.

The flutter about water gas at Liverpool, to which I have lately referred, appears likely to spread to other towns. It has turned up in some of the medical journals, and from thence been duly transferred to the columns of London dailies, who are always ready to toady the public taste by a kick at the gas companies. I need scarcely add that it has been treated in a style similar to those of the writers who warned the public that oysters are a source of typhoid fever, aniline dyes of skin disease, that by the apparently innocent process of eating watercress sufficient frog spawn may be taken to create a great deal of inconvenience at a future time, and that in every shoal of mackerel there are a few fish that have acquired violently poisonous properties. The result of all this chatter may, in some cases, be injurious to the interests of those who make or sell water gas apparatus or plant. In some cases the adoption of such happens to be just under consideration, and the poison scare is a first-rate weapon for the man who opposes expenditure in any shape or form. He solemnly warns the progressive party, who wish to develop their business and do their best for all concerned—consumers as well as shareholders—to pause and consider the responsibilities towards which they are blindly rushing. In towns where the works are the property of the municipal authorities, the situation is more strained, because the common councilman is obliged to keep a watchful eye on the prospects of the next election. Already the chairmen of gas committees have been worried with questions, and attempts are being made to limit the production of water gas. Persons who have gas coals to sell, can make a good deal out of the Liverpool case. So we may expect that the question will not be allowed to drop, though truth and common sense will triumph in the end.

The discussion will not be all in vain, however, if it renders more prominent the need for sound gasfittings. It is known to be a fact that, without employing a specialist from a distance, or other extraordinary means, a system of gas pipes supplying the various rooms in any ordinary building can be made absolutely gas tight in the first place, and maintained in sound condition without much trouble or expense. It is equally well known that in very few instances does this desirable state of things obtain. Large quantities of gas pipes are laid by contract, pipes and fittings of the cheapest form being put down by men who have no special training and are not encouraged in any way to form careful and painstaking habits. I have even known people to object to having gas pipes in the house, through being under the impression that leakage and a taint of gas about the place was a necessary and unavoidable consequence. Gas companies have no authority on the other side of the meter, and any suggestions they may offer are not always received in good part. Consequently they frequently have to bear the blame for big bills that are really due to the ignorance or negligence of the parties who supplied the materials or laid the pipes.

The use of gas has now attained such large proportions as to necessitate some legislative action on the matter of sound fittings. Perhaps it was not so important in the days when the gas supply for an average middle class house consisted of a ½-inch service and a 3 feet meter, with branches to three or four rooms. But the ½-inch service and 3 light meter, have now given way to the one with a 1½ inch with a 20 light meter, branches to nearly every room in the house, and a cooking stove, one or two gas fires, etc., with specially large supply pipes. I contend, if such a system of fittings is so far unsound that one must consider before supplying a mixture in place of straight coal gas through it, the prohibition of water gas is not a remedy for such an unsatisfactory state of things. Whether water gas is used or not, the fittings should be made sound, as the greatest crank in favor of coal gas would not contend that a taint of escaping gas was beneficial in any way apart from the financial aspect of the question. In any case the consumer loses his money and his temper—two losses that are rather intimately associated—and the gas companies have to labor under the charge of dear gas. The remedy is as simple as it is obvious, and is to be found by an extension of the system that has been so successfully supplied in the case of meters for some years. It is illegal to use a meter that has not been stamped as correct by a government inspector. The trifling fee that is necessary to cover the cost of such inspection is paid by the maker and charged as an item in the cost of the meter. If either party to the contract desire, the meter can be tested again at any time, and if found to be inaccurate the inspector decorates it with a large label warning all concerned that if they desire to continue the use of the meter, they can only do so by payment of a heavy penalty. It is as easy and as cheap to test a system of gasfittings as a gas meter. And if there was an office in every town from whence an inspector could be obtained to test a system of fittings when required and certify or condemn them as the case may be, it is probable that the advantages of such a plan would soon become so evident as to leave no necessity for resorting to compulsion, which is objectionable to many people, more particularly if it is for their good.

Meanwhile the best way of meeting the wild statements that usually accompany ignorant and prejudiced opposition is to resort to plain facts authoritatively set forth. This has been the course taken by the Birkenhead Corporation Gas Committee, who employed Prof. Vivian B. Lewes to make a report on the use of water gas. The conclusions arrived at by that gentleman are (1) That there is no danger in sending out as a town supply a mixture of coal gas with carbureted water gas, provided that the carbonic oxide in the mixture does not exceed 17 per cent. With the two gases as at present made this would give a limit of 50 per cent. (2) That mixtures containing 50 per cent. and under of carbureted water gas are for all practical purposes as good as coal gas, while for use in incandescent mantle lighting they are superior. Such a report coming from so good an authority is likely to lead to an endeavor to fix a carbonic oxide limit. And this, if successful, would mean an addition to our already bloated public testing laboratories, in the shape of analyses and reports as to the percentage of carbonic oxide present in the gases, legal expenses for prosecutions and for defending the same, all of which have to be defrayed by the public or by the gas consumer. If the amount that has been spent in testing illuminating power and sulphur impurities in London alone, and in disputes over the results of the tests, had only been devoted to the testing of consumers' fittings, as above described, some real benefit would have been afforded to the public and to users of gas.

Water gas has even been brought before Parliament. A few days ago a member asked the Secretary of State for the Home Department whether he was aware that the gas companies were making large quantities of water gas, and turning it into the mains with the coal gas, so that some cases of poisoning by gas had already occurred, and whether any means would be taken to protect the public against the mixture of this most poisonous substance with coal gas. Mr. Ritchie was not aware that any cases of poisoning had occurred in consequence of such a practice, but promised to make inquiries if particulars were furnished to him. From which it would appear that the Secretary of

State is as yet unimpressed by the vaporings that appear to have originated at Garston, Liverpool.

A somewhat curious dispute has arisen at Plymouth, which rather hinges upon the rights of consumers. A gentleman wrote to the Company and demanded that the wet meter at present in use should be changed for a dry one. The meter was tested and found correct and so the change was not made. Matters went on for a few months, and the consumer refused to pay for the gas he had consumed, raising the ingenious plea that as he had refused to take gas through a wet meter, he could not be made to pay for gas subsequently supplied through that medium. This attempt to obtain a free gas supply was naturally resisted by the Company, and the matter was carried before the law courts. There the defendant found that he must pay for the gas that he had consumed, so long as the meter used was correct, and that he could not dictate to the Company as to the kind of meter to be used. There may have been reasons for the action on the part of the Company in this particular case. Some few companies confine themselves to wet meters only, but the majority are not particular, and if a consumer has a preference for one or the other they usually meet his wishes. As the Sales of Gas Acts are quite silent on the point, it is not easy to see how anyone could expect to establish a legal right to one kind of meter or the other. But while the company cannot be forced to supply any particular make the consumer has an equal right. For he can provide a meter himself, and if it is properly stamped, the company cannot refuse to supply him through it. So in the above case it would have been open to the consumer to purchase the kind of meter desired on his own account, and to demand a supply through it. His mistake lay in claiming the right to make a new law and to force the Gas Company to abide by it.

Some attention has been attracted to the subject of columnless gasholders, in which the usual external guide framing is dispensed with, as advocated by Mr. Gadd, Mr. Lloyd Pease and others, by a disaster with a large gasholder at Middlesbrough, which occurred during the night of Saturday, 20th February. The holder was shut off at midnight, being then within a few feet of the top, or nearly full of gas. It is a 3-lift holder with steel tank entirely out of ground, and somewhere in the neighborhood of 180 feet diameter. Early on Sunday morning the watchman found that the outer and middle lifts were run down and gas leaking from the cup of the inner lift, while water was escaping from a split in the tank. The whole was lately erected by Messrs. Ashmore, Benson, Pease & Co., the guiding adopted being the wire rope and pulley system patented by a member of the firm. The question that arouses general interest is the extent to which the new system was responsible for the mishap. The tank itself has not proved a success. It was erected on a bed of concrete with extensions for columns, should it be desired to provide such at any future time, and as usual the concrete was extended 2 feet or so all round beyond the circumference of the tank. As soon as water was admitted it became evident that the foundations were not strong enough to support it. Settlement at once commenced, and at the time of the accident the whole had gone down a foot or more, but very irregularly, so that at places the tank was some inches out of level, the shape of the sides in horizontal section had become distorted, and the top edge was out of level also. Consequently it had been decided not to work the outer lift, a decision that does not appear to have been strictly observed. The tank had remained sound up to the present occasion. Some of the ropes and pulleys were broken, but the damage does not appear to have been of a substantial character, and fortunately the engineer at Middlesbrough has the summer before him, so that matters can be put right for next winter. Meanwhile the primary cause of the accident is being inquired into and will be the subject of independent report. The failure of the tank plate might have been the commencement, or, as a rough wind was going at the time, something might have broken in the guiding and holding-down device, and put a further strain on the tank, thus determining the fracture. There has been rather a disposition to withhold details, which is not altogether unwise under the circumstances. But the engineer's report, if published, will be an interesting document. The Middlesbrough tank is not the only columnless one in connection with which settlements have occurred, which seems to hint that the support furnished by the substantial piers for the columns in the usual plan of construction, should not be altogether dispensed with, especially in the case of tanks above ground.

THE Brooklyn Fire Brick Works will make an important addition to the bone black reburning benches in the plant of the Chesebrough Manufacturing Company, corner Richards and Delevan streets, Brooklyn, N.Y.

Profitable Day Load in Alternate Current Systems.

By MR. GEORGE T. HANCHETT, in *Electrical World.*

A profitable day load for an electric light station is highly desirable. There are, however, thousands of factories consuming large amounts of power, which are shut down all night, and while much capital lies idle in them, no complaint is made by stockholders in these manufacturing industries. A profitable night load has not been regarded as a crying necessity, but it has occurred to the writer that there must be many cases in which a combination of the lighting of a town, and the manufacture of woolen, paper and cotton goods could be profitably made.

The use of electric power in factories to avoid long lines of shafting and numerous belts, and the expense of maintenance and loss of power contingent upon them, has been generally accepted as a move in the right direction. Relative first cost of an electrically driven factory and one driven by shafting is, of course, slightly in favor of the latter, but the diminished cost of operation of the former has impelled many industries to make the change.

Now if in addition to the driving of the factory during the day the output of the generators could be turned into a system of street and house lighting at night, there would be a source of revenue equal to that of an electric light station of the same capacity and unencumbered with many expenses that an electric light station alone would involve.

The items of interest and depreciation on the plant would be divided by two. There would then be only interest and depreciation on the line, and on the transformer system if there was one.

The income from the station, less the expenses of night operation, would pay a percentage on the capital stock almost double that of an ordinary electric lighting station operating under the same load.

There are certainly many manufacturing towns where an electric lighting station would not pay, but where an arrangement of this kind would prove very profitable.

Where the establishment of an industry is contemplated it would certainly be a wise move to increase the capital stock a very small amount, use electrical transmission in the factory, and then obtain a franchise to supply the town with electric lights. Conversely, an electric lighting installation could make an arrangement with a local manufacturer, whereby he could obtain the advantages of the electric transmission in his factory, and the electric lighting station could obtain a day load. It is evident from a business point of view that it would be much better if the lighting and manufacturing interests were combined under one management, since there would then be harmonious operation.

In large cities where the power necessary to operate a factory would by no means be sufficient for the lighting of the place, a system of block lighting might be resorted to, each block being taken care of by one of the numerous manufacturing interests which a large city frequently contains. This block lighting competition has been pointed out by other writers to be a most formidable foe to the central station, but coupled with the manufacturing interest as set forth in this article it would be well nigh invincible.

A word or two about the best machines to use in such service will be appropriate. A combined motor and lighting load suggests to the electric lighting man a direct current system, but it is very doubtful whether this would be advisable. In small towns where the number of subscribers would not be many, an expensive line, which in this kind of a station is really the major cost of the system, would not be justifiable. In large cities the block or district which was lighted by the factory plant might be at some distance from the factory, so that an alternating line would be imperative, and therefore as far as the lighting is concerned an alternate current system would generally be preferable. It will immediately be argued that there is no alternate current system which is perfectly satisfactory for both lighting and power, and the time-worn objection of inferior regulation would probably be offered.

The writer has no patience with the latter objection. The boasted precise regulation of direct current systems, as obtained in large cities, is secured at the expense of vigilant hand regulation, and there is no earthly reason why alternate current systems will not regulate equally well. If the compound alternator was tabooed in the central station as the compound direct current machine has been, the results would be just as satisfactory.

Through the ingenuity of Mr. John F. Kelly an alternating current booster has been devised which has neither commutator nor brushes, and is in every way simpler than the direct current booster, which comprises two machines and two commutators. With the alternating booster any feeder may be combined in precisely the same way as in direct current stations.

The device of providing bus bars of different voltages and a switch

throwing a feeder on to any one of these bus bars at pleasure, can be accomplished in the alternating current system with a single machine, and in fact every aid to exact regulation that the direct current system has can be obtained in the alternating, with perhaps the exception of the storage battery.

The flexibility of distribution on alternate current systems has numerous advantages which need not be mentioned here.

The first objection is, however, more serious. It is certainly true that neither two nor three phase systems are satisfactory for both power and lighting. The unbalancing of the circuits is, of course, a popular objection, and usually the one that first comes to mind, but there is a more serious annoyance. It very often happens that a heavily loaded circuit requires more than one-half the output of the machine, and that another circuit is so lightly loaded that the other half of the machine has power to spare. The engineer may therefore see his machine with one side overloaded and be unable to relieve it with the ample power of the other side because it is in a different phase. The writer has suggested in other articles the device of coupling two alternators together at 90° or 120° apart to produce two or three phase currents and thus enable a power load to be carried, but this device is peculiarly adapted to the combined manufacturing and lighting interests referred to in the first part of this article. By a suitable coupling it can be arranged to be the work of but a few moments to change the alternators from 90° of phase to exact synchronism, thus changing the two phase station into a single phase station. These alternators can be directly coupled to either side of a moderate speed engine, provided the plant is large enough to admit of such large machines as these will necessarily be, or two alternators can be set upon the same base and have a common driving pulley. During the day the station can be a two or three phase station and drive the factory by means of induction motors, which, in their entire absence of commutators, brushes and collecting devices are ideal for the use, or rather abuse, of ignorant factory hands, since they can never get out of order. After the factory is shut down, a few moments' work changes the station into a single phase station to meet the lighting load which will probably begin to come on. It is obvious that two such generators are bound to operate to complete satisfaction in multiple; they can never get out of step. When operating as two phase generators the phases may be regulated by the varying of the field currents one absolutely independent of the other, and a formidable objection to the two phase generators as ordinarily constructed is thus overcome.

It will be well to have two generating sets, both of them adjustable to either single or multiple phase out-puts, one of them large enough to carry the factory day load and the lamp night load, and the other of suitable size, and evidently much smaller, to carry the lamp day load and the motor night load. The little machine would save interruption of service, which is most important, and would also carry such motor load as might be on after the factory was shut down. During the day it would probably be better to shut it down for the larger generator could undoubtedly carry the day load on one or both of its phases. With such an installation every conceivable convenience which electricity affords could be used in the factory and a profitable and satisfactory light service could be established.

With regard to the use of direct current apparatus in such an installation it is necessary to say but little; it is so thoroughly familiar to every electric lighting man that there is no doubt that if used it would be arranged to best advantage. It is well to mention, however, that in comparison with the alternating system it is peculiarly at a disadvantage in such an installation as this. In the first place, there is no doubt of the almost infinite superiority of the induction motor over the direct current motor; and in the second place, one of the principal economies of the alternating system is first cost in the line. This as previously stated would form about 50 per cent. of the capital stock of the lighting interests of such a combination, and would be entirely too large a factor to be overlooked.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

A CORRESPONDENT at Huntsville, Ala., asks the following questions: "Will you please let me know how much gas a 1¼ inch pipe would supply at an elevation of 1,200 feet and a run of 17,000 feet? Also, what would be the smallest pipe that would supply 400 lights, at the same elevation?"

THESE questions are by no means complete, and in order to answer them the conditions about the case are thus pieced out. The diameter of the pipe is 1¼ inches; its length is 17,000 feet; the pressure (assumed) is 14-10ths; the specific gravity (assumed) of the gas is, 450; barometer, 28.66 inches correction for elevation above sea level; temperature, 60° F.; elevation above sea level, 1,200 feet; delivery at sea level (normal barometer 30 inches) equals 55.2234 cubic feet per hour; delivery at 1,200 feet elevation above sea level, 57.6532 cubic feet per hour. If rise is 1,200 feet, the pressure on pipe being zero at sea level, the flow at point of delivery will be 160.900 + cubic feet per hour.

As to the second question: The smallest pipe that would satisfactorily supply 400 burners, consuming 5 cubic feet per hour each, under first condition above given is 2½-inch, the connection to the distributing pipe being made at a central point, the burners being equally distributed on either side of such connection. Under second condition—*i. e.*, if rise instead of elevation above sea level is meant—the conditions under which the gas would be burned would regulate the size of pipe to be chosen. The pressure being excessive would admit of the requisite amount to supply the burners being distributed through a 1-inch pipe. The service, however, would not be satisfactory unless some governing device were introduced; and under this latter practice in reality the same dimension of pipe as in the first instance would be required. As a guide for correctness either way the difference of 1 inch in the pressure of the gas will cause a difference in the volume of .0024. For example: 1,000 cubic feet of gas under 4 inches pressure when distributed at 1-inch pressure, will measure 1007.02 cubic feet.

AT the annual meeting of the Belvidere (Ills.) Gas Light and Fuel Company the officers chosen were: Directors, F. S. Rowan, W. T. Longcor, J. L. Witbeck, G. H. Hurlbut and P. R. Kennedy; President, G. H. Hurlbut; Secretary, P. R. Kennedy; Treasurer, Irving Terwilliger. The annual reports were very favorable, and the outlook for the year is excellent.

A CORRESPONDENT in Sandusky, Ohio, writing under date of April 23d says: "At the annual meeting of the Sandusky (Ohio) Gas Light Company a 5 per cent. dividend was declared. The following officers, to serve during the ensuing year were elected: President, Charles W. Sadler; Vice-President, George P. Butler; Secretary, Charles H. Moss; Treasurer, A. C. Moss; Superintendent and Purchasing Agent, Emil G. Schmidt. The Company expended $22,000 in improvements during the year. The principal betterments were a new set of 10 feet by 14 feet by 4 feet purifying boxes, a revivifying floor and an electric elevator for hauling the oxide. In the electric plant a 600-horse power, tandem, compound condensing E. P. Allis engine was installed; also, a 150 kilowatt monocyclic alternator, and 65-light Brush arc machine."

THE Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnishing to the government of Limon, Costa Rica, a market building constructed entirely of steel. The framework of the building will be of light skeleton steel work, and the roof covering will be galvanized iron with ornamental nesting and cornices. The building is to be constructed in the form of a quadrangle 120 feet square; the interior court will be 40 feet square—in the center will be placed a fountain—and each side of the quadrangle will be 40 feet wide. Completely surrounding the building will be placed an ornamental iron fence, pierced with large entrance gates. The gate posts will be surmounted by elegant wrought iron lamps. The whole design of the market is neat and attractive in every way.

JUDGE CADY, in the Syracuse (N. Y.) Municipal Court, recently handed down an important decision in the suit of the Syracuse Gas Company against Charles T. Snavlin, which proceeding was brought to establish a precedent. The defendant, who is a contractor, while constructing a sewer in Pearl street, Syracuse, dug underneath the Gas Company's main. Later on the filling underneath the main settled, and the pipe was fractured. The suit was brought to establish the Gas Company's right to obtain damages. Judge Cady found for the plaintiff, awarding $10 damages (nominal) and costs.

THERE is some probability that the Brockton (Mass.) Gas Light Company will put up a new plant on a site for which the Directors are now said to be negotiating.

AT the annual meeting of the Bridgeport (Conn.) Gas Light Company the following officers were chosen: Directors, W. R. Higby, S. C. Trubee, W. D. Bishop, W. B. Hincks, A. J. Hobbs, E. G. Burnham, M. B. Beardsley, N. W. Bishop and H. F. Greenman; President, W. R. Higby; Secretary and Treasurer, F. B. Sammis; Superintendent, C. A. Gerdenier.

At the annual meeting of the Savannah (Ga.) Gas Light Company the officers chosen were: Directors, H. H. Gilmer, W. M. Low, J. C. Rowland, J. H. M. Clinch, A. R. Lawton, Jr., Jacob Rauers, John Nicolson, Jr., and J. F. Minis; President, A. G. Guerard. The only change was the naming of Col. A. R. Lawton, Jr., to succeed the late General A. R. Lawton.

The works at Merced, Cal., are to be overhauled.

The following is the text of the proposed agreement between the authorities of Winnipeg and the proprietors of the Manitoba Gas and Electric Light Company respecting the franchise extension asked for by the latter:

1. That the city of Winnipeg shall enter into an agreement with the Manitoba Gas and Electric Light Company for the reduction by the Company of the price of gas to be sold and supplied in the city of Winnipeg at rates not exceeding the following, viz.: For illuminating gas at the rate of $2 per 1,000 feet, with a reduction of 10 per cent. for payment within 10 days from the first day of each month, and for heating purposes at the rate of $1.50 net per 1,000 feet, such reduction of price to be carried into effect on the ratification of this by-law as hereinafter provided.

2. Said agreement shall also provide that the said Company shall, during the season of 1897, extend its mains in the city of Winnipeg for the supply of gas to an extent not less than 10 miles in the streets of the city of Winnipeg, and shall, during the said year, make such other improvements and additions to its works as shall enable the said Company to provide the increased supply necessary for its present system and the said increased mileage.

3. The said agreement shall also contain a provision that hereafter, in cases where any street or part of street, not less than 1,000 feet in length, in the city of Winnipeg, is built upon and improved by buildings on at least one-half of the lots thereon, and where the owners of a majority of lots on said street or streets shall furnish to the Company (Council of the city of Winnipeg) an agreement in writing executed by them, binding themselves on being supplied by said Company with gas for the buildings on said lands at the then current price of the Company for the same to take the same when supplied for use in the buildings (and on the Council of the city of Winnipeg requesting the Company to extend its mains and pipes, so as to supply the said street or portion of streets) the said Company will thereupon extend its mains and pipes from its system of pipes so as to connect with the said street or streets, or part of the street, so as to supply gas to the buildings in respect of which such contract has been entered into, and for the purpose of this clause, frontage on a street of 50 feet shall be considered as one lot, and the frontage shall extend from the point of connection with the Company's system.

4. The said agreement shall also provide that in consideration of the reduction of the price of gas so to be granted by the above Company as above set forth and said increased mileage, the said Company shall have the exclusive right to make, sell and supply gas for lighting or heating purposes, within the limits of the city of Winnipeg, for the period of 25 years from the date of the ratification of this by law.

5. The said agreement shall also provide that the city of Winnipeg, in consideration of the benefits to be derived from the completion of the said agreement will ask and apply for the ratification of this by-law and of the agreement by the Legislature of Manitoba.

Mr. Frederick Egner, writing to the Journal, from the Hotel du Nord, Cassel, Germany, under date of April 14th, says: "To-day I saw an ideal model gas works, at this city of Cassel. It was erected in 1894, within the short space of nine months from the time that the first shovelful of earth was dug up for the foundations until gas was made. The designs and plans were furnished by the Engineer-Manager of the municipal gas plant of this city, Mr. Emil Merz. That gentleman received me in a most affable, friendly manner, and personally conducted me through the whole plant, explaining the numerous novel features as we went along. I said it was an ideal gas works. By this I mean that, in practical design, it is arranged about as perfect in every detail, from the bringing in of the coal to the sending out of the gas and the disposition of the residual products, as I imagine it possible to conceive a coal gas works. I have secured 18 large photographs of the plant. * * * They have only slopers at work here, and I remained during the drawing and charging this morning, and when I tell you that, upon comparing the same with work I did recently—works, or rather benches on the same pattern were ordered for some Belgian, Swiss and German cities—enough is said. I have been given some most interesting data concerning the heating, etc., of the slopers here; but have not time to translate them now, or I would—as I intend to later on—and send them to you. I find that Mr. Alexander H. Streckler was also here. * * *."

The Victoria Paper Mills Company, of Fulton, N.Y., is making extensive additions and alterations to its plant, one of which additions will make what is termed its new mill building, No. 3. The walls of this addition are to be of substantial brick construction. The floors are to be carried by steel girders supported by the side walls and interior steel columns, and the roof, which is to be gravel on plank, will be carried by steel trusses. This will make a neat building, thoroughly fireproof and well adapted to its purpose. The contract for furnishing and erecting the steel work has been awarded to the Berlin Iron Bridge Company, of East Berlin, Conn.

At the special meeting of the stockholders of the Louisville (Ky.) Gas Company, held on the morning of April 22d, for the purpose of deciding upon the ways and means of securing the funds necessary for the proposed improvements on the plant, the following disposition of the subject was reached:

"*Resolved*, That a committee, consisting of Mayor George D. Todd, J. D. Taggart, H. V. Loving, J. W. Ainslee, K. W. Smith and J. A. Cheek, be and the same is hereby appointed for the purpose of 'considering the affairs' of the Louisville Gas Company, and to determine what steps, if any, are necessary to be taken looking to the reconstruction and extension of a part of the Company's plant, as proposed by its Board of Directors.

"Said committee is authorized and empowered to call to its aid, if it deems it necessary, gas experts, as well as expert accountants, all expense attending same to be borne by the Gas Company.

"*Resolved*, That this committee report the results of its investigations, with any recommendations it may seem proper to make, to a subsequent meeting of the stockholders, to be called by said committee."

The majority report of the committee appointed by the City Council of Houston, Texas, to consider the application of the Houston (Texas) Gas Light Company for a renewal of its franchise, is as follows—the committee consisted of six members, five of whom agreed on the majority presentation:

"We, members of your committee on gas franchise, after looking into the matter carefully, getting all the data that we could on the subject from the Gas Company and other sources, prompted by a desire to do justice to the Gas Company as well as to the city of Houston, do recommend that this Council grant a new franchise to the Gas Company for 15 years, based on its putting the maximum price of illuminating gas at $1.50 per 1,000 cubic feet, and furnishing the city market house, police and fire stations with gas free. Fuel gas not to exceed the price of illuminating gas,"

Correspondence

[The Journal is not responsible for the opinions expressed by correspondents.]

Mr. Highlands Takes Part in the Criticism.

Clinton Gas Light and Coke Company,
Clinton, Ia., April 19th, 1897.

To the Editors American Gas Light Journal:

In your issue of April 5th I notice an entirely unnecessary fling at the writer, by a person of the name of Lloyd, in which he refers to a paper I read at the Pittsburgh meeting of the Western Gas Association. From the tone of Mr. Lloyd's letter I would imagine that he knows but very little more about the Welsbach lights, or the influences which led up to the writing of the article I read at Pittsburgh, than he does of the manufacture or operation of a gas engine. I am certain that the gas fraternity are indebted to Mr. Brown for the correct and fearless manner in which he read the riot act to the gas engine makers of this country, and if Mr. Brown's article will only succeed in bringing the builders of gas engines in America to a proper understanding of the merits of the case, he will have accomplished a great deal of good. As for myself, I certainly do not ask any sympathy at the hands of this person, on account of my having read the article in question; but I do most positively object to having my name used in connection with such a senseless tirade as that of Mr. Lloyd's. And I would say, further, that when the gentleman is able to go into the shop and build as good an engine as he thinks he can, I will gladly give him an order for a couple of them myself.

Very respectfully, S. M. Highlands.

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MONDAY, MAY 3, 1897.

The Destruction of Iron Pipes by the Carbonic Acid Dissolved in Water.

The London *Journal* says that researches by Mr. R. Petit, described in *Comptes Rendus*, throw some light on the destructive action of certain waters on iron pipes; and they also bear upon the question of the purification of water by iron. Waters which contain little lime but an appreciable quantity of dissolved carbonic acid were observed to exercise a solvent action on iron, and the course of the action was traced. A known quantity of iron filings was placed in each of three vessels, which were respectively filled with ordinary river water, and the same water after carbonic acid had passed through it for a few minutes, and after the addition of sufficient lime to just neutralize the dissolved carbonic acid. The vessels were sealed by mercury from contact with the air; and after the lapse of a certain time, the iron dissolved in each was determined. In the first case, the water had dissolved about 0.0003 per cent., and in the second 0.02 per cent., of its weight of iron; while in the third, only traces of iron could be detected. The water in the second case was clear; but on standing exposed to the air, ferric oxide separated. It was therefore inferred that waters containing carbonic acid and very little lime dissolve iron as ferrous carbonate. The latter is then decomposed by the oxygen of the air, and ferric oxide is deposited and carbonic acid formed. The latter can again attack the iron; and thus water containing little carbonic acid may have a very powerful action on iron pipes.

The effect of certain saline solutions on iron was observed in a similar manner, both in the presence and in the absence of dissolved carbonic acid. The solutions were of about 0.1 gramme per liter, of calcium chloride, sodium chloride, potassium sulphate and calcium nitrate. They were allowed to act on the iron filings in sealed vessels for 11 days at a room temperature of about 54° F. Each salt was found to form a specific quantity of ferric oxide independently of the presence of carbonic acid. When this was present, a quantity of iron was in addition taken into solution. In the case of potassium sulphate, the carbonic acid dissolved 14.8 per cent. of the iron filings, while about 7.6 per cent. of ferric oxide was found, whether carbonic acid was present or absent. In the absence of carbonic acid, the iron dissolved was so little that it was scarcely recognizable by the sulphocyanide test. Repeating these experiments with access of air, ferric oxide separated, but the iron in solution remained the same. The quantity of oxide increased with the lapse of time, and with the solution of calcium chloride, as much as 36.9 per cent. of the iron taken was thus converted into oxide.

The Market for Gas Securities.

Nothing of particular interest can be reported respecting the course of the market for city gas shares during the week. Consolidated sold off about 3½ points on realizing sales, and the opening to-day (Friday) in it was made at 159 to 161. Mutual, Equitable and Standard show advances over the quotations of last week, while New York and East River is weaker, on comparatively few and small transactions. The rate bill, according to our latest advices, remains where it stood at time of last writing; but there is little doubt that it will speedily become a law. All classes of city shares are cheap at the market. Brooklyn Union remains firm, at 104½ to 105, and the bonds are 112½ bid.

Chicago was active during the week, but the quotations show no net change in its value. Bay State is weak and lower, on the fear that the main responsibility for the Boston explosion will be put upon it. So far, from the testimony taken before the Board of Gas and Electric Light Commissioners, we fail to discern why such fear should exist. Consumers, of Jersey City, is 78 bid, ex div.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

MAY 3.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	159	161
Central	500,000	50	195	..
" Scrip	290,000	..	100	.
Equitable	4,000,000	100	212	213
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	2,500,000	100	245	255
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	54	55½
Preferred	2,000,000	100	89	91
Bonds 1st 5's	3,500,000	1,000	108	109
" 1st Con. 5's	1,500,000	..	100	101
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	96	97½
Preferred	5,000,000	100	114	115
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	113
Yonkers	299,650	50	180	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	104¼	105
" " Bonds (5's)	15 000,000	1,000	112¼	..
Bay State	15,000,000	50	8¾	10
" Income Bonds	2,000,000	1,000	..	35
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	85
2d " " "	3,000,000	1,000	70	72
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	81⅛	81¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	72	74
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	78	81x
" Bonds	600,000	1,000	102	103
Cincinnati G. & C. Co.	8,500,000	100	201¾	202
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	85
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	59	59¼
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	.	22	..
" Con. Bonds	4,812,000	..	72½	74
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	88
" Bonds	2,000,000	..	89	92
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	132	135
" Bonds, 6's	2,650,000	..	105½	107½
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	84	88
Bonds	1,000,000	1,000	92	95
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	22	22¼
Preferred	2,500,000	100	73	
Bonds	9,084,400	1,000	97	97¼
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10.000,000	100	97¾	98¾
St. Paul Gas Light Co.	1,500,000	100	79	81
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500.000	25	..	..
Washington, D. C.	2,000,000	20	250	
Western, Milwaukee	4,000,000	100	65	67
Bonds, 5's	3,556,000	.	94	94½
Wilmington, Del.	550,000	50	200	202

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Helme & McIlhenny, Phila., Pa..... 715

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M. J. Drummond, New York City..... 718
R. D. Wood & Co., Phila., Pa..... 710
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Donaldson Iron Co., Emaus, Pa..... 718

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Berwind-White Coal Mining Co., New York and Phila. . 704
Althouse & Kennedy, Phila., Pa..... 691

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Perkins & Co., New York City 704
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The Sun Oil Co., Pittsburgh, Pa..... 705

COKE CRUSHER.

C. M. Keller, Columbus, Ind..... 705

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C. W. Hunt Company, N. Y. City 698

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The Wilder Mfg. Co., Phila., Pa 695
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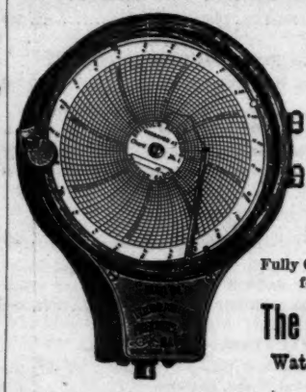

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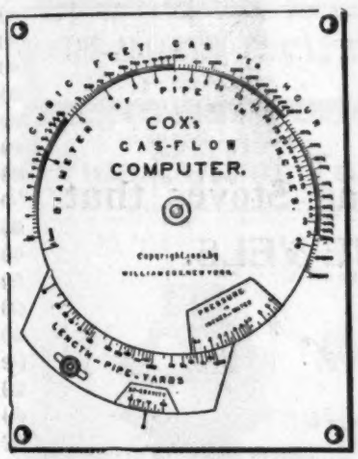

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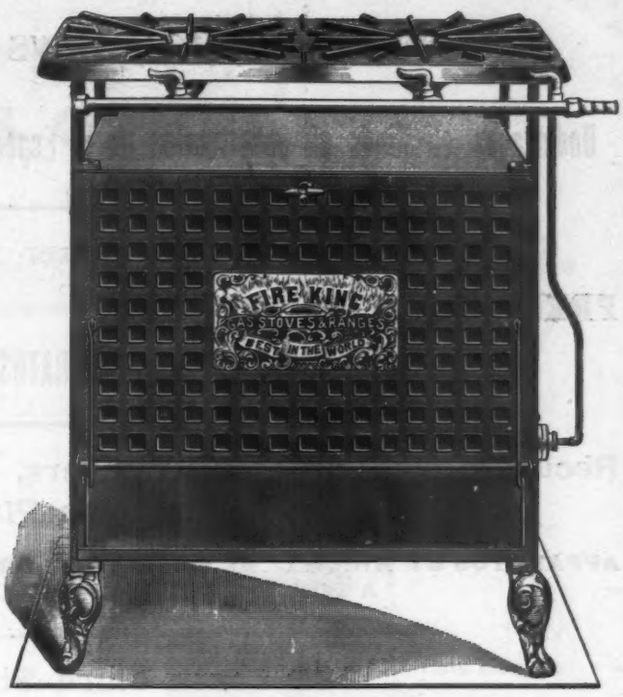

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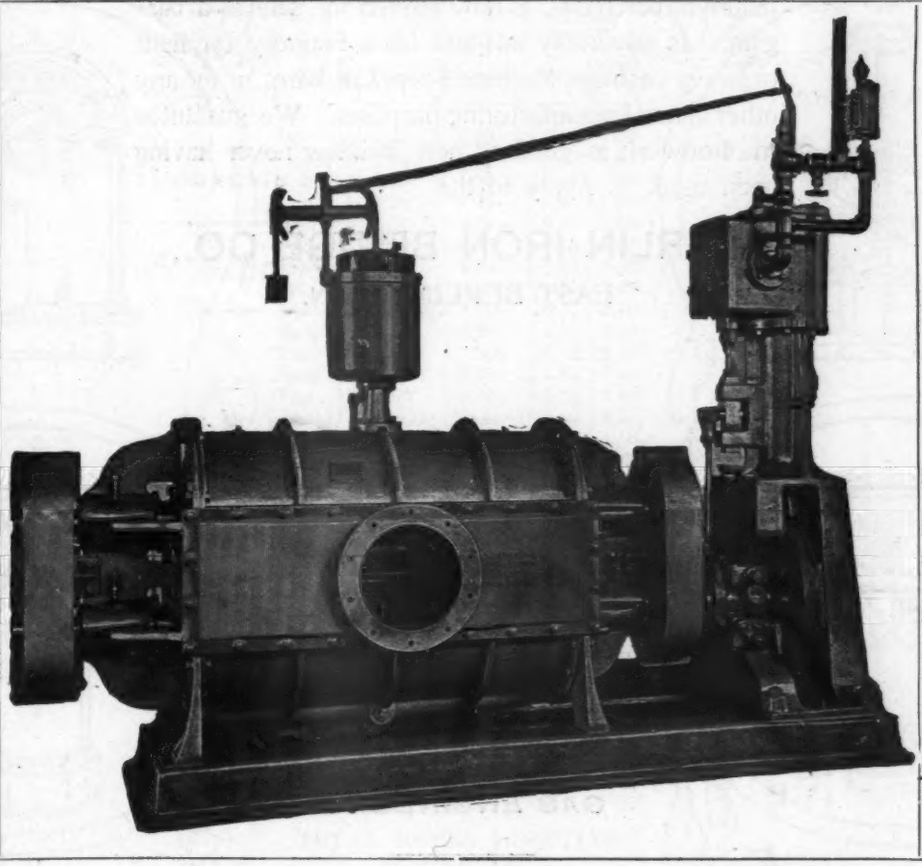

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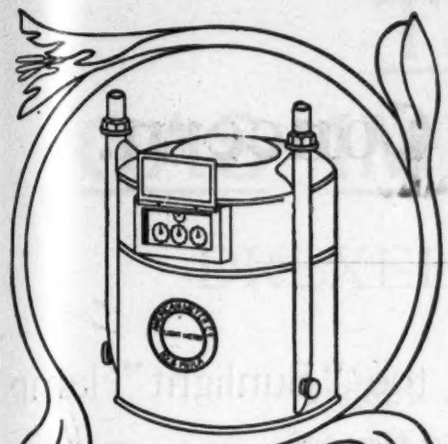

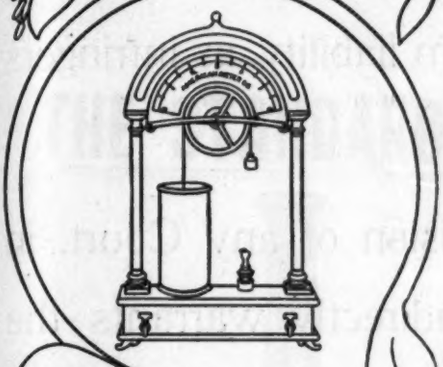

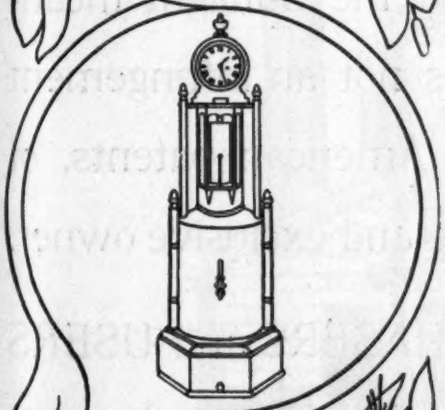

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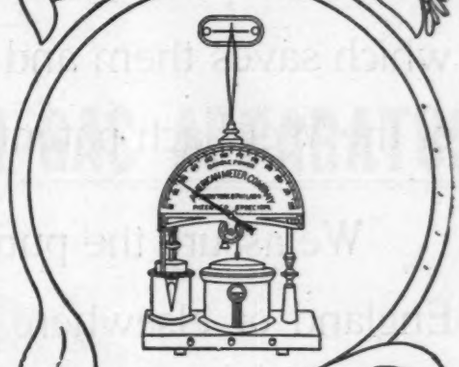
PUBLIC LIGHTING TABLE.

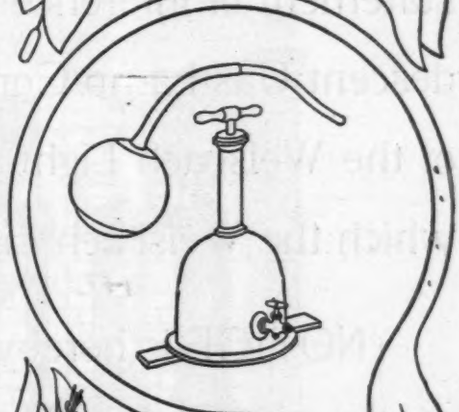
MAY, 1897.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sat.	1	7.20 PM NM	4.00 AM	6.45	4.00
Sun.	2	7.30	4.00	6.45	4.00
Mon.	3	7.30	4.00	6.45	4.00
Tue.	4	7.30	4.00	6.45	4.00
Wed.	5	7.30	4.00	6.45	4.00
Thu.	6	10.40	4.00	6.45	4.00
Fri.	7	11.10	4.00	6.55	3.40
Sat.	8	11.50	4.00	6.55	3.40
Sun.	9	12.10 AM FQ	3.50	6.55	3.40
Mon.	10	12.40	3.50	6.55	3.40
Tue.	11	1.10	3.50	6.55	3.40
Wed.	12	1.30	3.50	6.55	3.40
Thu.	13	2.00	3.50	6.55	3.40
Fri.	14	No L.	No L.	7.00	3.30
Sat.	15	No L. FM	No L.	7.00	3.30
Sun.	16	No L.	No L.	7.00	3.30
Mon.	17	7.40 PM	10.10 PM	7.00	3.30
Tue.	18	7.40	11.10	7.00	3.30
Wed.	19	7.40	12.00 AM	7.00	3.30
Thu.	20	7.40	12.40	7.00	3.30
Fri.	21	7.40	1.10	7.10	3.15
Sat.	22	7.40 LQ	1.40	7.10	3.15
Sun.	23	7.50	2.00	7.10	3.15
Mon.	24	7.50	2.20	7.10	3.15
Tue.	25	7.50	2.40	7.10	3.15
Wed.	26	7.50	3.00	7.10	3.15
Thu.	27	7.50	3.40	7.10	3.15
Fri.	28	7.50	3.40	7.15	3.15
Sat.	29	7.50	3.40	7.15	3.15
Sun.	30	7.50 NM	3.30	7.15	3.15
Mon.	31	7.50	3.30	7.15	3.15

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	233.00	January	423.20
February	187.20	February	355.25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45





To Whom It May Concern.

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We assure the public there is no decision of any Court, in England or elsewhere, that directly or indirectly warrants the statement or inference that the lamp sold by the Sunlight Incandescent Gas Lamp Company of America is not an infringement of the Welsbach Light as made under the American patents, of which the Welsbach Light Company is sole and exclusive owner.

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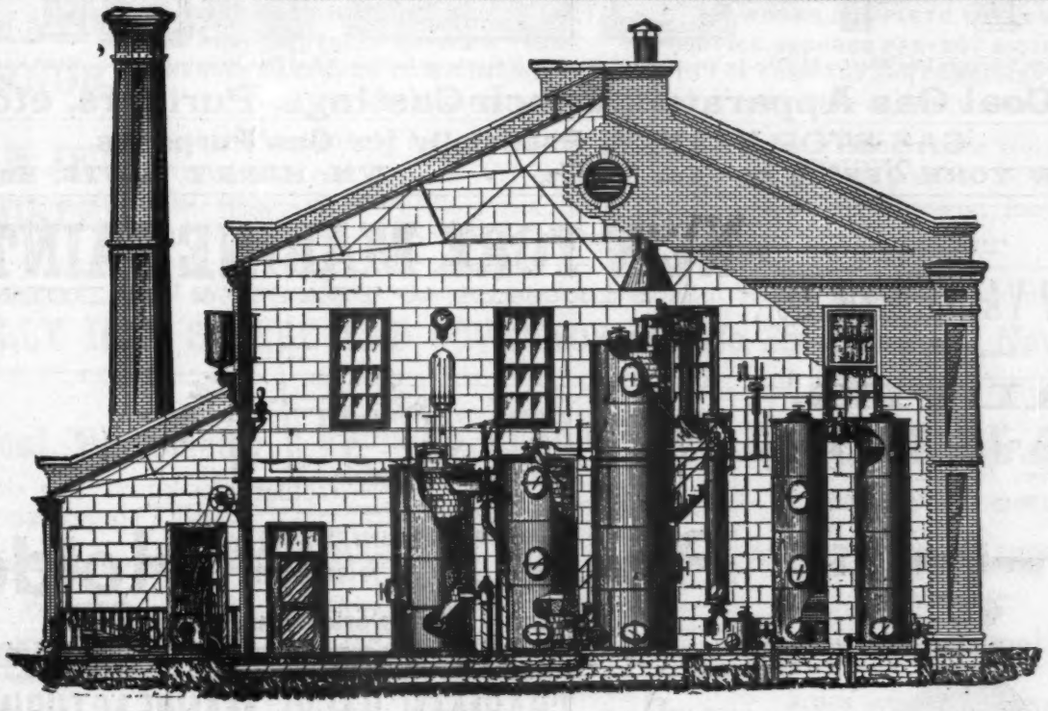

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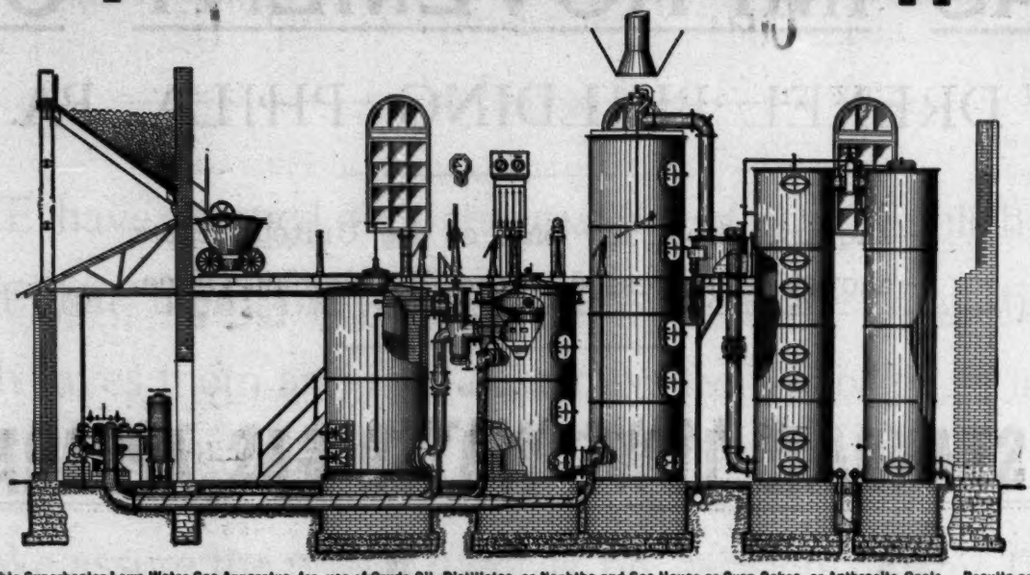

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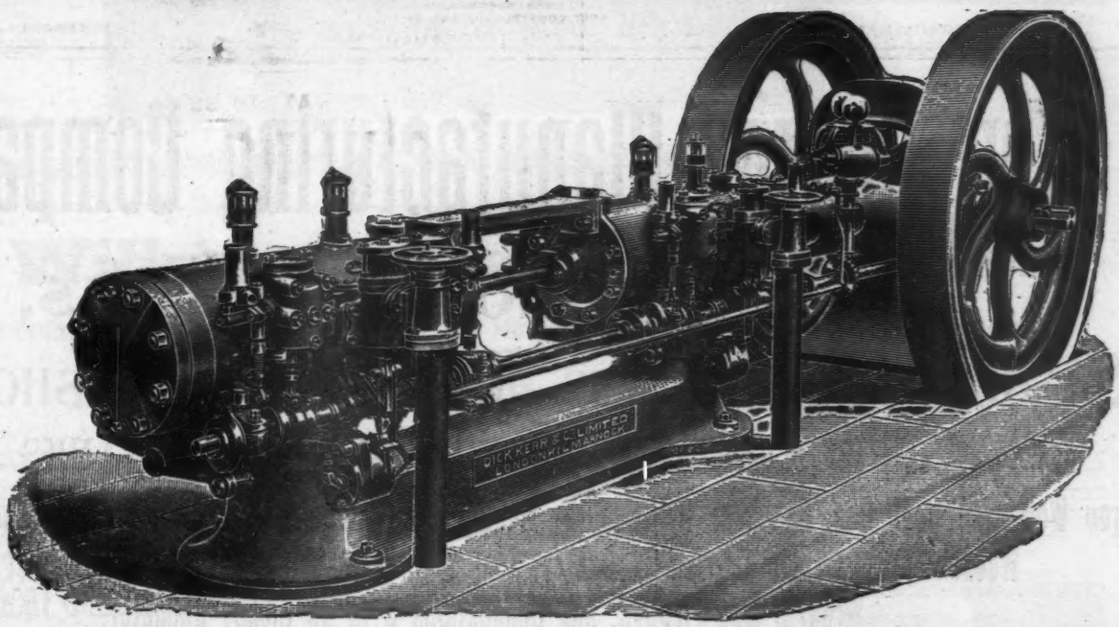

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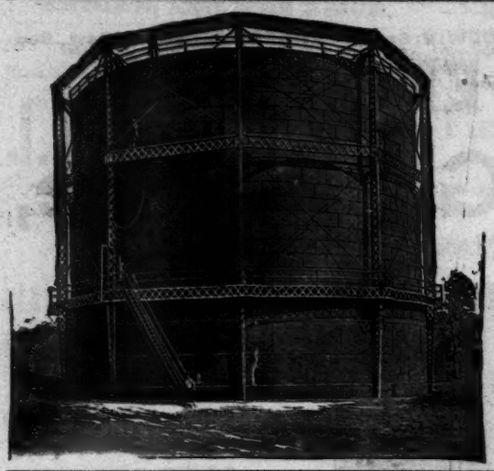

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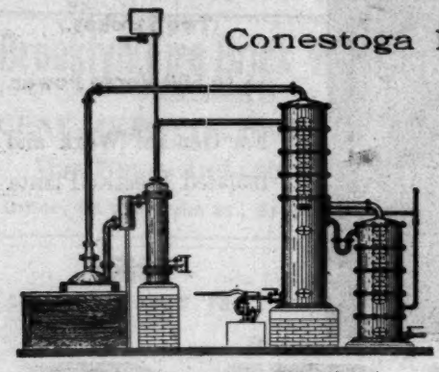

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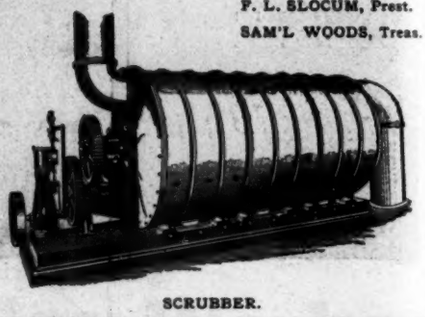

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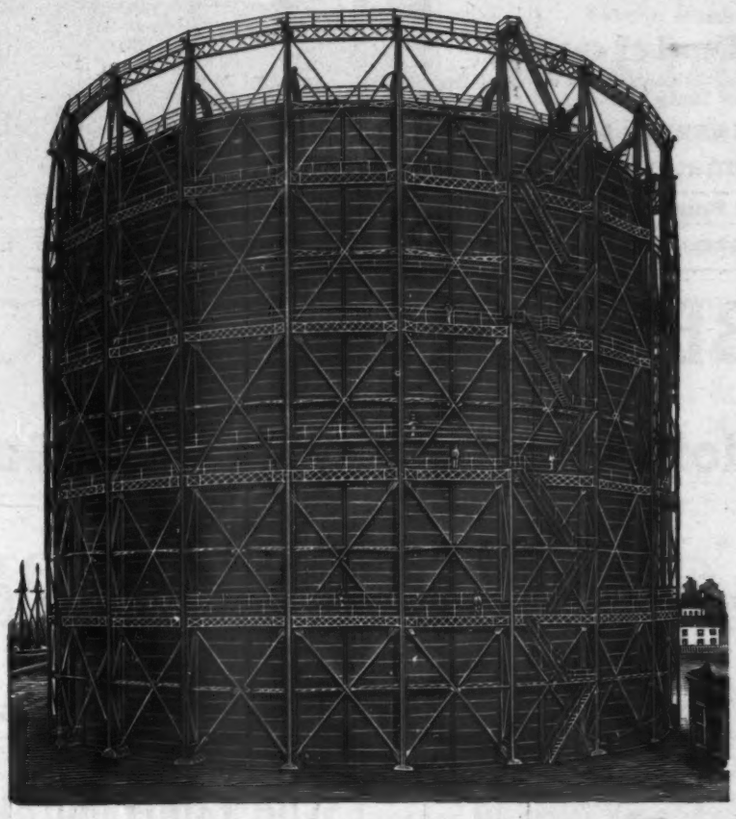

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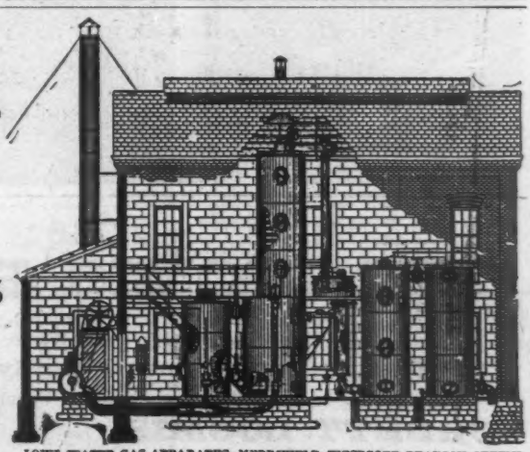

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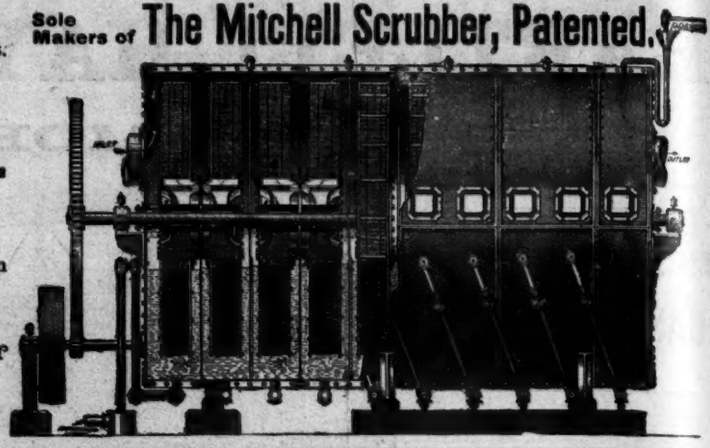

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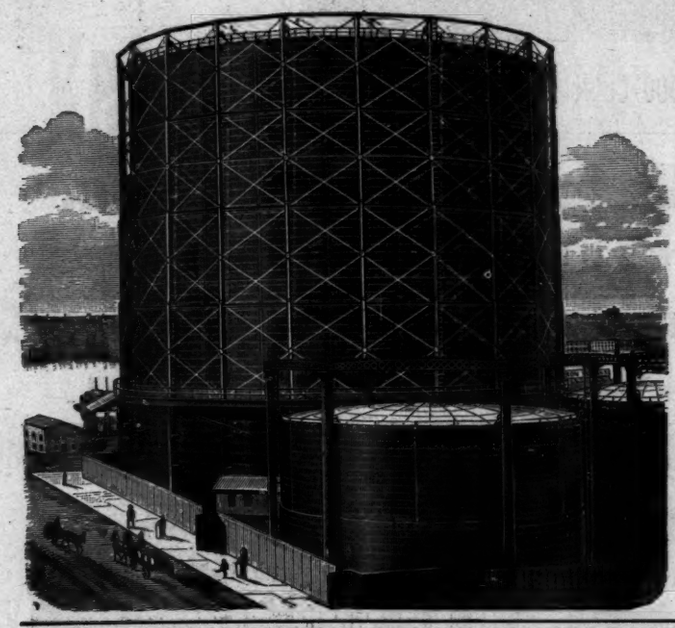

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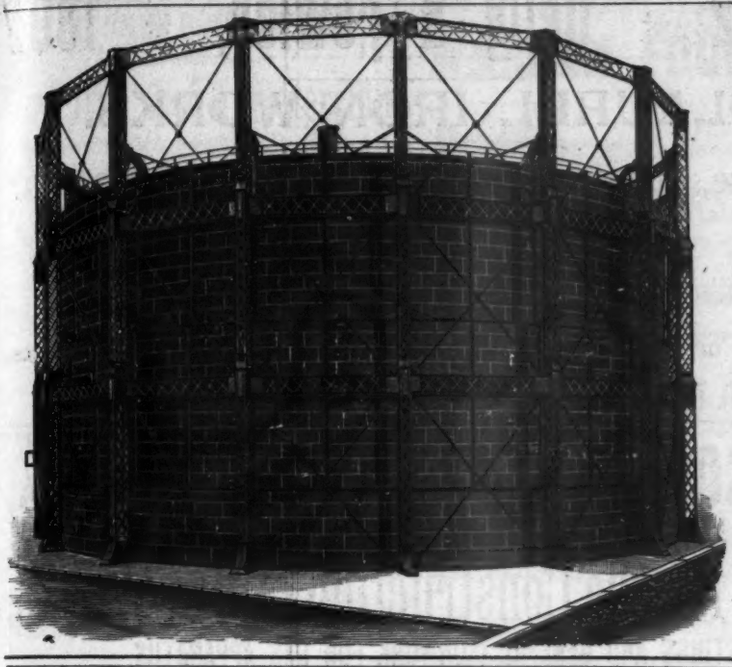

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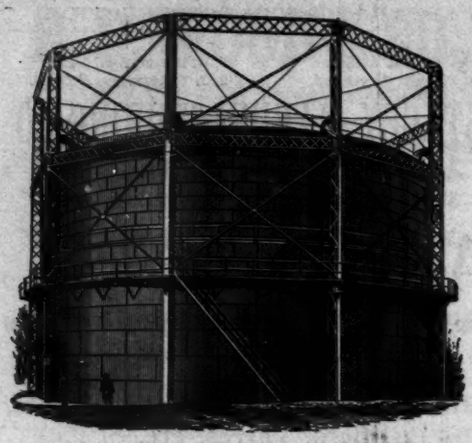

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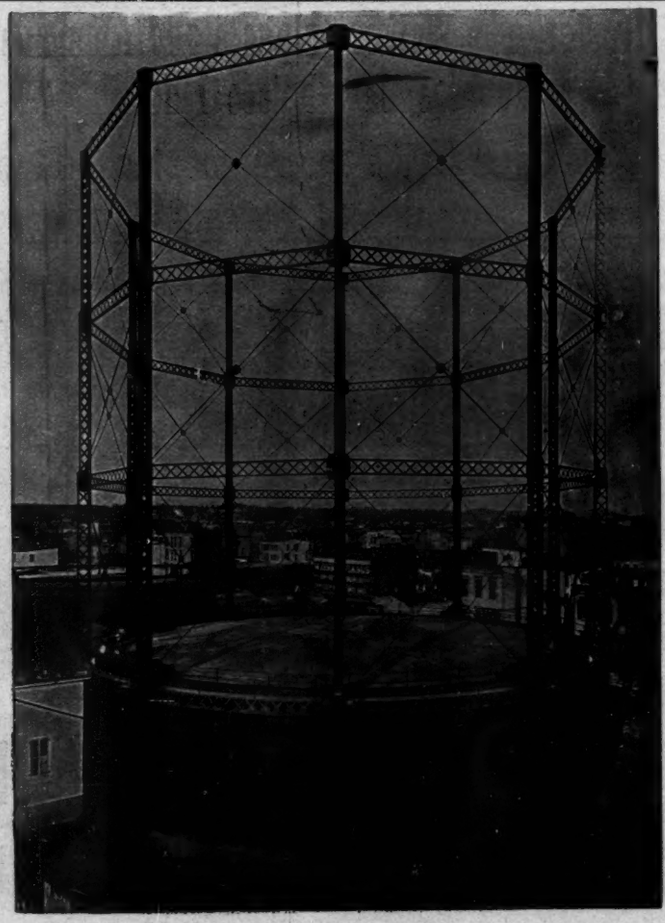

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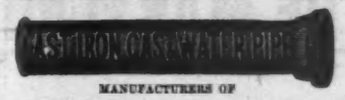

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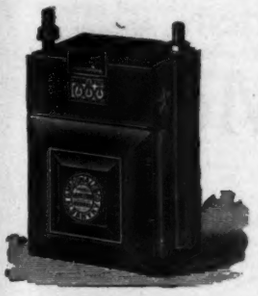

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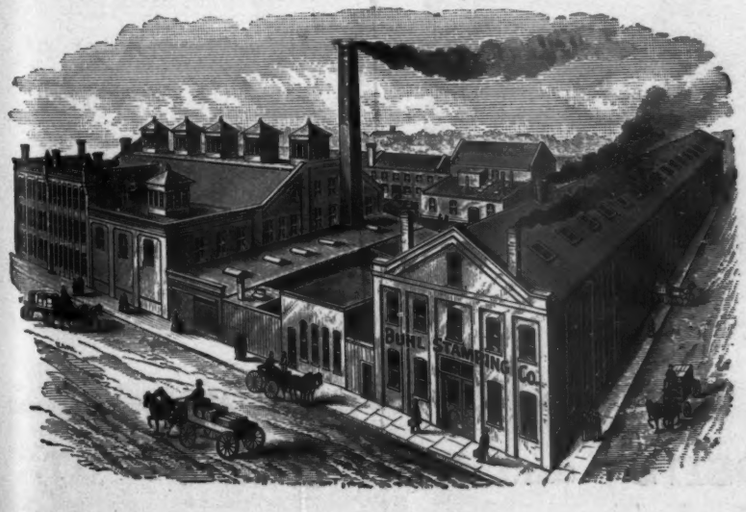

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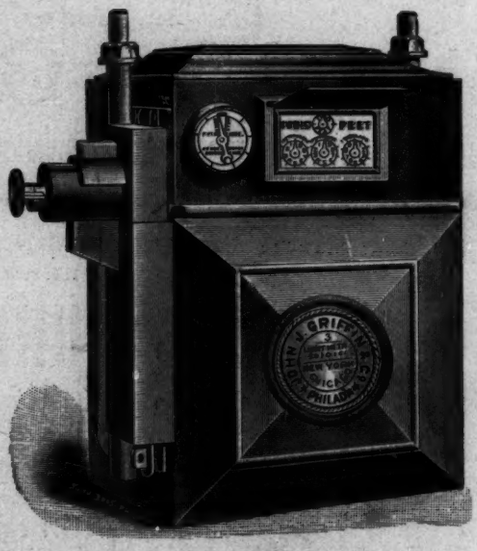

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